

Temperature Controllers

Phoenix P240 PID Controller 4 Digit 1/8 DIN

- Easily Programmed From the Front Panel
- SMART Auto-tuning for Automatic Adjustment and Continuous Tuning of Optimum Control Parameters
- Full PID or On/Off Control
- Dual Display: Both Measurement and Set Point Values
- Choice of T/C, RTD or Linear inputs (J, K, L, N, R, S, RTD Pt100, mA, mV, or V)
- Up to 3 Independent Alarms With Choice of Process, Band, or Deviation Alarms and Automatic or Manual Reset
- Optional Heater Break Detection
- Standard Screw Terminal Connector With Safety Cover
- Auxiliary Set Point Standard



Simpson's new Phoenix Series PID controllers offer ease of use and full PID control for a variety of thermocouple, RTD, or linear inputs. The controller can operate in the standard PID control mode for both heating and cooling, with on-demand SMART Tuning to automatically set the optimum PID parameters. The P, I, and D actions are also manually adjustable over a wide range. On/Off control operation is key-pad-selectable.

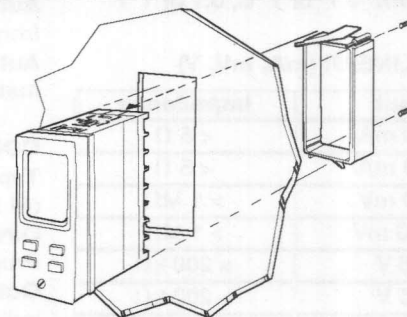
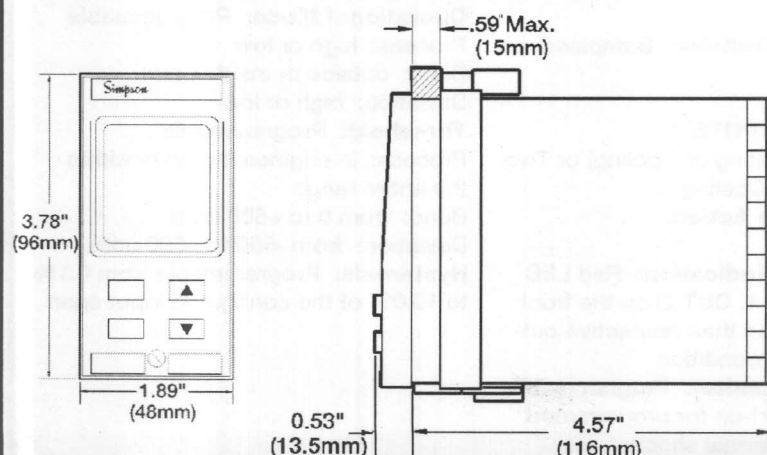
Three outputs are standard on the P240, allowing for both heating and cooling control. Up to three alarms are available and can be configured as process,

band, or deviation alarms with automatic or manual reset. The safety lock feature provides password protection.

Model P240 features a dual, 4-digit LED display with LED indicators for output and alarm status. Screw terminal connectors are standard for easy wiring, and a rear safety cover is included.

The model P240 fits the standard vertical 1/8 DIN panel cutout (45mm X 92mm) and requires only 116mm depth behind the panel. The front panel offers IP65/Nema 4X protection.

Installation and Panel Cutout



Mounting Instructions

Insert the Phoenix into the panel cutout through the front. From behind the panel, slide the white mounting bracket over the Phoenix, gently pulling the tabs out to move the bracket. The mounting screws and tabs should be on the top and bottom of the controller. Push the bracket forward until it is flush with the panel, then tighten the mounting screws to hold the Phoenix in place.

Specifications

DISPLAY

Type: Dual 4-digit LED
Upper (yellow-green): Process measurement value
Lower (orange): Set point value

POWER REQUIREMENTS

AC Voltages: 100 to 240 VAC $\pm 10\%$, 50/60 Hz OR 24 VAC $+10/-15\%$

DC Voltages: 24 VDC $+10/-15\%$

NOTE: 24V AC/DC is available on special order.

Power Consumption: 8 VA

ACCURACY @ 25°C

$\pm 0.2\%$ of full scale

ENVIRONMENTAL

Operating Temperature: 0 to 50°C

Storage Temperature: -20 to 70°C

Relative Humidity: 20 to 85% non-condensing

Warm-up Time: None required

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: 120 dB, 50/60 Hz

ANALOG TO DIGITAL CONVERSION

Technique: Dual slope integration

Sampling Time: 250ms (Linear inputs)
500ms (T/C and RTD inputs)

INPUT: THERMOCOUPLE

Types: J, K, L, N, R, S (either °C or °F)

Cold Junction Compensation: automatic from 0 to 50°C ambient temp.

Error: 0.1°C/°C

Input Impedance: $> 1 \text{ M}\Omega$

Resolution: 0.1° or 1° C; 1° F

INPUT: RTD (.00385 alpha)

Type: Pt100 3-wire (either °C or °F)

Line Resistance: Max 20 Ω /wire with no appreciable error

Resolution: 0.1° or 1° C; 0.1 or 1° F

INPUT: LINEAR (mA, mV, V)

Input	Impedance
0-20 mA	$< 5 \Omega$
4-20 mA	$< 5 \Omega$
0-60 mV	$> 1 \text{ M}\Omega$
12-60 mV	$> 1 \text{ M}\Omega$
0-5 V	$> 200 \text{ k}\Omega$
1-5 V	$> 200 \text{ k}\Omega$
0-10 V	$> 400 \text{ k}\Omega$
2-10 V	$> 400 \text{ k}\Omega$

MECHANICAL

Bezel: 1.9" x 3.8" (48 x 96 mm)

Depth: 4.57" (116 mm)

Panel Cutout: 1.8" x 3.6" (45 x 92mm 1/8 DIN)

Case Material: black ABS

Front Panel: IP65, Nema 4X protection in accordance with CEI 70-1 req.

Weight: 0.8 lb (400 g) max.

CONTROL CHARACTERISTICS

Control Method: PID with SMART Tune for Auto and Adaptive tuning, or ON/OFF. Choose ON/OFF Control by setting Proportional Band = 0

Proportional Band: Programmable

For 1 control output: from 1.0% to 100.0% of the configured input span

For 2 control outputs: from 1.5% to 100.0% of the configured input span

Integral Time: Programmable from 20 seconds to 20 minutes, or excluded

Integral Pre-load: Programmable
For 1 control output: from 0% to 100% of the output range

For 2 control outputs: from -100% to +100% of the heating/cooling output range

Derivative Time: Programmable from 1 second to 10 minutes, or excluded

Output 1 (Heating) Cycle Time: Programmable from 1 to 200 seconds

Hysteresis (for ON/OFF control): Programmable from 0.1% to 10.0% of the configured input span

In the Case of 2 Control Outputs:

Relative Cooling Gain:

Programmable from 0.20 to 1.00

Cooling cycle time: Programmable from 1 to 200 seconds

Overlap/deadband: Programmable from -20% (deadband) to +50% (overlap) of the proportional band

NOTE: These Output 2 parameters will be automatically set during configuration according to the cooling medium (air, oil, or water) selected.

Auto/Manual Mode: Selectable from front panel

Auto/Manual Transfer: Bumpless method

CONTROL OUTPUTS

Type: One (Heating or Cooling) or Two (#1 Heating, #2 Cooling)

Direct/Reverse Action: Programmable

Output Status Indication: Red LED indicators (OUT 1, OUT 2) on the front panel are lit when their respective output is in the ON condition

Output Level Limiter: Programmable
Operates at start-up for programmed time to avoid thermal shock.

For 1 control output: from 0% to 100%

of the output span

For 2 control outputs: from -100% to +100% of the Output 1 (Heating) span

Relay Outputs:

Output cycle time: Programmable from 1 to 99 seconds

Output 1 (Heating): 3 Amp, 250 VAC SPDT contact

Output 2 (Cooling): 2 Amp, 250 VAC SPST contact

Logic Voltage for SSR Driver

(Output 1 only):

Logic Level 0: Vout $< 0.5 \text{ VDC}$

Logic Level 1:

14 VDC $\pm 20\%$ @ 17 mA max.

24 VDC $\pm 20\%$ @ 1 mA max.

Output Safety Value: When the instrument detects an out-of-range or a burn-out condition, it can force the output to a programmed safety value.

OUTPUT POWER OFF FUNCTION

This function allows the instrument to operate as an indicator by disabling the control output, removing power from the controlled load. It is therefore possible to continue monitoring the process variable even if the load is off.

ALARMS

Alarm 1 may be selected in lieu of Output 2 and Alarm 2 in lieu of Output 3. An Alarm 3 is available as an option.

Alarm Functions: Process alarm, Band alarm, or Deviation alarm

Alarm Reset: Either Automatic or Manual reset

Masking: Each Alarm can be configured as masked, to avoid false alarm indication at start-up or after a set point change

Alarm Indication: LED indicators are lit when the respective alarm is ON

Alarm Output: 2 Amp, 250 VAC SPST contact

Operational Mode: Programmable
Process: high or low
Band: outside or inside band
Deviation: high or low

Threshold: Programmable
Process: in engineering units within the entire range

Band: from 0 to +500 units

Deviation: from -500 to +500 units

Hysteresis: Programmable from 0.1% to 10.0% of the configured input span

Control Action

ON / OFF CONTROL

This is the simplest form of temperature control. An ON/OFF controller switches the output when the temperature crosses the set point. For heating applications, the output is ON (at 100%) below the set point and OFF (at 0%) above the set point; the opposite is true for cooling applications.

If the ON and OFF points were actually the same, the relay would cycle rapidly as the process temperature crossed the set point. To prevent this "chatter," a dead-band, or Hysteresis, is added to the control operation. This Hysteresis sets a band around the set point that the temperature must cross before the output can be switched on or off again, eliminating rapid cycling.

The Phoenix can be configured for ON/OFF control by entering the Operation Parameter mode and setting the Proportional Band (Pb) = 0.

PID CONTROL

PID Control adds Proportional, Integral and Derivative action to ON/OFF Control in order to more closely regulate the process temperature. It is recommended for processes subject to wide temperature cycling or sudden changes in process temperature or load.

Proportional Action adjusts the output as soon as the process temperature enters a selected **Proportional Band** around the set point. The output is controlled proportionally to the difference between the set point and the actual process temperature. As the measured value approaches the set point, the output level gradually decreases until the temperature stabilizes.

In reality, Proportional Action usually brings the process temperature very close but not exactly to the set point. This difference is called "offset".

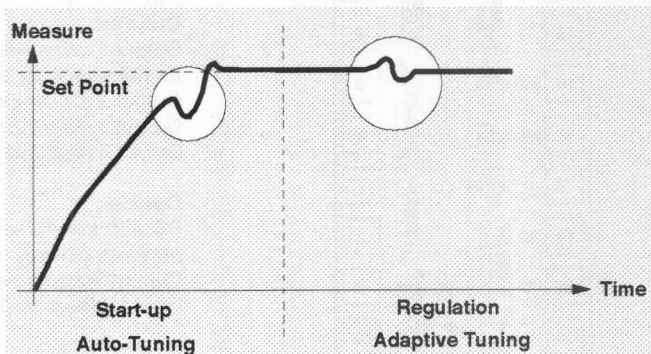
Integral Action automatically corrects this offset by measuring the difference between the set point and the measured value and then shifting the Proportional Band accordingly. Integral Action is expressed in minutes and seconds, representing the time needed to reset the Proportional Band. For this reason, Integral Action is often referred to as "reset".

Derivative Action enables the controller to react to rapid changes in the process temperature -- for example, a sudden rush of cooler material into the flow. The output is adjusted in proportion to the rate of change in the process temperature over the set derivative time. Derivative Action is therefore often referred to as "rate".

With the Simpson Phoenix PID controller, the PID values can be selected by the user in the Operation parameter setting mode. However, SMART Tuning will monitor the process and automatically set the optimum PID parameters.

SMART Tuning

Simpson's Phoenix PID controller is equipped with a SMART self-tuning algorithm. SMART Tuning enables the controller to automatically adjust the PID parameters to the optimum levels according to the process conditions.



At Start-Up

SMART implements auto-tuning function to calculate optimum PID values for best approach to set point.

During Regulation

SMART continually monitors the process and updates the PID parameters as the Phoenix adapts to changes in either set point or load.

To enable SMART Tuning, press FUNC until the "Snrt" parameter appears in the lower display. Press ▲ or ▼ until the upper display reads On, and press FUNC again to enter. The SMART LED indicator will be flashing during auto-tuning and lit during continuous adaptive tuning.

NOTE: While the SMART Tuning function is enabled, the control parameters (Pb, ti, td) may be displayed but not modified.

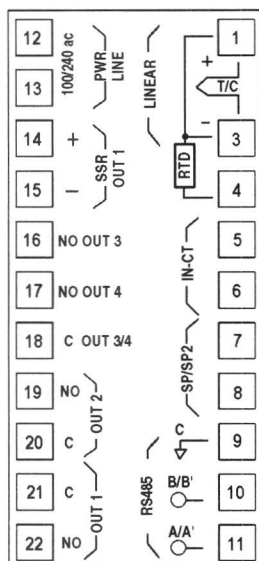
To disable SMART Tuning, press FUNC until the "Snrt" parameter appears in the lower display. Press ▲ or ▼ until the upper display reads OFF, and press FUNC again to enter. The SMART LED indicator will turn off.

Soft Start

Simpson's Phoenix PID controller is equipped with a Soft Start function to gradually warm up the process temperature. Soft Start takes effect immediately at start-up, limiting the output power level in order to avoid thermal shock.

Output during Soft Start is determined according to the Output High Limit (OLH) and Output 1 Cycle Time (CY1) operating parameters. OLH sets the percentage of the CY1 time that the output power will be ON during Soft Start. For example, if CY1 = 15 seconds and OLH was set at 50%, then the heating output would only be ON for a maximum of 7.5 seconds during Soft Start.

Wiring Diagram



Supply Power: Connect the power (100-240 VAC) to terminals #12 and #13.

Input Signal:

Thermocouples are connected to terminals #1 and #3.

RTDs are connected to terminals #1, #3, and #4.

Linear (mA, mV, V) inputs are connected to terminals #1 (IN HI) and #3 (IN LO).

Outputs:

Output 1 (main Heating or Cooling output) is connected to terminals #21 (C) and #22 (NO) for Relay; #14 (+) and #15 (-) for SSR.

Output 2 (Cooling output or Alarm output) is connected to terminals #19 (NO) and #20 (C).

Output 3 (Alarm 2 output) is connected to terminals #16 (NO) and #18 (C).

Output 4 (Optional Alarm 3 output) is connected to terminals #17 (NO) and #18 (C).

Options:

RS 485 interface is connected to terminals #11 (A/A'), #10 (B/B'), and #9 (C). (*Not presently offered*)

Current Transformer for Heater Break Detection is connected to terminals #5 and #6.

Input for Auxiliary Set Point is connected to terminals #7 and #8.

CAUTION

The Solid State Relay option (SSR) is a logic voltage for a SSR driver. Be sure to connect to a SSR driver and not directly to the load.

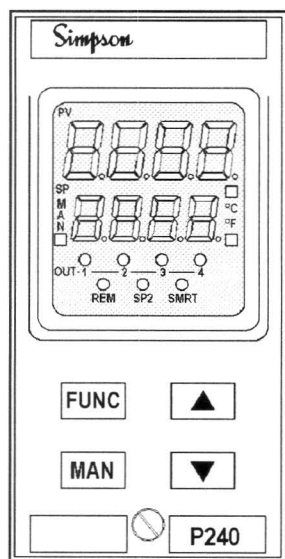
CAUTION

Before switching the instrument on, make sure the supply voltage is within the range required as indicated on the hook-up label affixed to the instrument.

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

P240 Display



KEYPAD DESCRIPTION

- Decreases the selected parameter value.
- Increases the selected parameter value.
- FUNC** Displays parameters in sequence and enters new values. Also displays output level and heater current.
- MAN** Switches from Auto to Manual mode.
- + **FUNC** Enables/Disables the OUTPUT POWER OFF function.

DISPLAY

Upper Display: Process measurement value (yellow-green)

Lower Display: Set point value (orange)

LED INDICATORS

MAN Lit when the instrument is in Manual mode.

°C / °F Indicates the selected engineering unit.

OUT 1 Lit when OUTPUT 1 (Main Output) is ON.

OUT 2 Lit when OUTPUT 2 is ON, if Cooling Output is selected, OR when ALARM 1 is ON, if Alarm 1 is selected.

OUT 3 Lit when ALARM 2 is ON, OR Flashes slowly when Heater Break Detection is active, OR Flashes rapidly when ALARM 2 and HBD are both active.

OUT 4 Lit when Alarm 3 is ON.

REM Indicates that the instrument is being operated via serial link. (*Not presently offered*)

SP2 Lit when Auxiliary Set Point is used and flashes when a set point from the serial link is used.

SMRT Indicates SMART Tuning function is active. Flashes during auto-tuning. Lit during adaptive tuning.

Operation

SIMPLE SET-UP

Starting PID Control can be accomplished simply by connecting the instrument, selecting the desired set point and alarm values, and turning on SMART Tuning. Just follow these easy steps:

1) Install the Phoenix P240 in the panel and connect wiring according to diagram. Apply power.

2) Select the set point and alarm values (if any). The parameter code will appear in the lower display, and the parameter value or status will be shown in the upper display.

Press the FUNC button. "SP" (set point) will appear. Use the ▲ or ▼ buttons to reach the desired set point value*. Press FUNC again.

"Snrt" (for SMART Tuning) will then appear. Press ▲ or ▼ to switch SMART to On, then press FUNC. Press FUNC again to scroll past "n.RSt" and once more past "nnn".

"SP2" will appear next if the Auxiliary Set Point has been selected. Use ▲ or ▼ to select the desired second set point value*. Press FUNC.

"AL1" will appear if Alarm 1 has been chosen. Use ▲ or ▼ to set the desired Alarm 1 value. Press FUNC, and "HSA1" (Alarm 1 Hysteresis) will appear. Use ▲ or ▼ to enter the Hysteresis value*, if desired, then press FUNC. Repeat for AL2 and AL3 if ordered.

3) When finished, do not press any buttons for 30 seconds. The instrument will then exit Operating Parameter mode and begin process control.

OPERATING PARAMETERS

For those who wish to manually enter the PID parameters or program the control outputs, following is a complete list of the Operating Parameters, described in the order in which they appear.

To enter the Operating Parameter mode, press FUNC and release. When setting the Operating Parameter values, the lower display will show the parameter name, and the upper display will indicate the value of the parameter or whether it is ON or OFF. Use the ▲ or ▼ keys to select the desired value or ON/OFF status. To enter and move to the next parameter, press the FUNC button. When finished, wait 30 seconds for the instrument to return to control mode.

NOTE: Some of the following parameters may be skipped, depending on the instrument configuration. Factory default values are listed in () parentheses.

SP Set point, expressed in engineering units. (Minimum range value) *

Snrt SMART Tuning function status. Setting this status to On enables the SMART function. Setting it to OFF disables the SMART function.

n.RSt Manual Reset of Alarms. If Manual Reset has been ordered for the alarms, set to On to reset the alarms. (OFF)

nnn Safety Lock parameter protection. On indicates that the parameters are locked, except for set point and manual reset. OFF indicates that the parameters are unlocked. To change the ON/OFF status, enter the password 853. (OFF) Available only when Password Protection has been selected.

SP2 Auxiliary set point, expressed in engineering units. (Minimum range value) *

AL1 Alarm 1 Threshold, expressed in engineering units. This is the value at which Alarm 1 will be activated. (Process alarm: minimum range value. Band/Deviation alarm: 0)

HSA1 Alarm 1 Hysteresis, expressed as a percentage of the configured input range span. (0.1%) *

AL2 Alarm 2 Threshold, expressed in engineering units. This is the value at which Alarm 2 will be activated. (Process alarm: minimum range value. Band/Deviation alarm: 0)

HSA2 Alarm 2 Hysteresis, expressed as a percentage of the configured input range span. (0.1%) *

AL3 Alarm 3 Threshold, expressed in engineering units. This is the value at which Alarm 3 will be activated. (Process alarm: minimum range value. Band/Deviation alarm: 0)

HSA3 Alarm 3 Hysteresis, expressed as a percentage of the configured input range span. (0.1%) *

Pb Proportional Band, expressed as a percentage of the configured input range span. The Phoenix PID tuning logic operates within this band to adjust the output until the temperature just reaches the desired set point. (4.0%) *

hYS Hysteresis for ON/OFF control action only, expressed as a percentage of the configured input range span. (0.5%) *

ti Integral Time, expressed in minutes and seconds as "mm.ss". This represents the time required to reset the Proportional Band in order to bring the temperature exactly to the set point. (4.00)

td Derivative Time, expressed in minutes and seconds as "mm.ss". This represents the rate required to overcome deadband and shift the Proportional Band in order to com-

pensate for a sudden change in process temperature. (1.00)

CY1 OUTPUT 1 Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 1. (15 sec. for Relay output, 4 sec. for SSR output)

CY2 OUTPUT 2 Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 2. (10 sec. for Air as cooling medium, 4 sec. for Oil, 2 sec. for H2O)

rC Relative Cooling Gain, in minutes and seconds. This is the relative gain for OUTPUT 2 when used as a Cooling Output. (1.00 for Air as cooling medium, 0.80 for Oil, 0.40 for H2O)

OLAP Deadband or Overlap between the Heating and Cooling Outputs, expressed as a percentage of the Proportional Band. (0%)

rL Set point low limit, expressed in engineering units. (Initial scale value) *

rH Set point high limit, expressed in engineering units. (Full scale value) *

Grd1 Ramp applied to a positive set point change, expressed in digits per minute. This is the rate at which the process will ramp up to a new, higher set point. (Infinite)

Grd2 Ramp applied to a negative set point change, expressed in digits per minute. This is the rate at which the process will ramp down to a new, lower set point. (Infinite)

OLH Output high limit, expressed in % of the output. This limit is based on the amount of time OUTPUT 1 is ON vs. the Cycle 1 time. (100%)

tOL Time duration of the output power limit, in minutes. This is the amount of time OLH is active. When tOL = Infinite, OLH is always active. (Inf)

Hbd Threshold value for Heater Break Detection alarm, in Amperes. (50% of current transformer range)

* NOTE: To achieve optimum PID performance, the actual input range span is narrower than listed: T/C °F input = 600°; T/C °C = 500°; RTD °F = 600°; RTD °C = 500°. (Linear input span is set by the user.) Hysteresis functions, Proportional Band, and Set Point limits are determined by this span. If this configured input range span is too narrow for one or more of these desired parameter settings, contact Simpson Technical Support for adjustment instructions.

Operation cont.

DISPLAY FUNCTION

In normal display mode, the upper display indicates the measured value, while the lower display shows the set point value.

The lower display can be used to show other information as follows:

- 1) Press the FUNC button and hold for three seconds. If Heater Break Detection (HBD) has been selected, the lower display will show "A." followed by the OUTPUT 1 current level as measured by the HBD current transformer.
- 2) Press FUNC again. The lower display will now show "H." followed by the OUTPUT 1 power value, expressed from 0 to 100 %. This represents the time OUTPUT 1 is ON vs. the Cycle Time.
- 3) If OUTPUT 2 has been selected as a Cooling Output, press FUNC again. The lower display will show "C." followed by the OUTPUT 2 power value.
- 4) Press FUNC again to return to normal display mode.

NOTE: Failure to press a button within 30 seconds will cause the display to return to normal display mode. To keep one of the above values on the lower display, press ▲ or ▼ to cancel the timer function. When ready to return to normal display mode, simply press FUNC again.

DIRECT ACCESS TO SET POINT

It is possible to change the set point without going through the entire Operating Parameter selection.

Make sure the Phoenix is in Auto Mode and normal display mode (no parameters are being modified). Press ▲ or ▼ and hold for two seconds. The set point value in the lower display will begin changing.

Press ▲ or ▼ until the desired set point value is reached. This new set point value will take effect after a two-second delay with no buttons being pressed.

MANUAL MODE

The output power levels may be manually adjusted in Manual Mode. When the Phoenix is operating in normal display mode, the Manual Mode function can be accessed by pressing MAN for more than one second. The MAN LED indicator will flash to indicate that the instrument is in Manual Mode.

The OUTPUT 1 power output value is shown (in %) in the two most significant digits of the lower display. The OUTPUT 2 % value, if any, appears in the two least significant digits. These output values can be modified by

pressing ▲ or ▼.

To return to Auto Mode, press MAN again for more than two seconds. The transfer between Auto and Manual Mode is bumpless.

NOTE: If the instrument is turned off while in Manual Mode, it will revert to Auto Mode PID control when powered up again.

OUTPUT POWER OFF FUNCTION

The Phoenix P240 can be operated as an indicator by turning off the control output power. To disable the output power, make sure the instrument is in normal display mode, then press ▲ and FUNC simultaneously for 5 seconds.

The P240 will now function as an indicator. "OFF" will appear in the lower display. Alarms, if any, will be in non-alarm condition.

To restore the control output power, press ▲ and FUNC simultaneously for 5 seconds.

ERROR MESSAGES

The Phoenix PID controller performs self-diagnostic testing and indicates on the display any errors detected.

Overrange: 0000

Underrange: _000

Sensor Lead Break:

T/C, RTD, mV: Overage

mA, V: Underrange

Coded Messages

When other errors are detected, "Err" appears in the lower display and the corresponding error code (e.g. "100," "200") shows in the upper display.

NOTE: Contact Simpson Technical Support at (708) 697-2260 for instructions on how to correct the error condition or to return the instrument for repair.

CONFIGURATION

The configuration parameters of this instrument have been programmed according to the part number ordered. If the original application changes, the instrument can be reconfigured by Simpson or by an authorized Phoenix modification center. Call Technical Support at (708) 697-2260 for more details.

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

Options

HEATER BREAK DETECTION

An optional alarm is available on the Phoenix to monitor the OUTPUT 1 (Heating) load current. The Heater Break Detection (HBD) function measures the current flowing through the power line of the equipment being controlled by OUTPUT 1. If the current level drops below the pre-determined HBD threshold value, the alarm is triggered and the OUT 3 LED indicator will flash.

The sampling of the load current will occur only if the power output has been applied to the load for at least 50ms.

NOTE: A current transformer with 50 mA AC secondary is required for the Heater Break Detection option. For ordering information, see the Accessories section on the last page.

AUXILIARY SET POINT

A logic input provides a second set point on the Phoenix. This auxiliary set point is useful in applications that call for a different temperature to be maintained during non-working hours, or for processes where the material may be changed, eliminating the need for a separate controller.

Transfer from the main set point (SP) to the auxiliary set point (SP2) and vice-versa is driven by logic input (contact closure). The transfer may be done via ramp or via step transfer.

Auxiliary Set Point is standard on the P240. However, the operating set point (SP or SP2) must be selected by external contact, at terminals #7 and #8.

Application Example

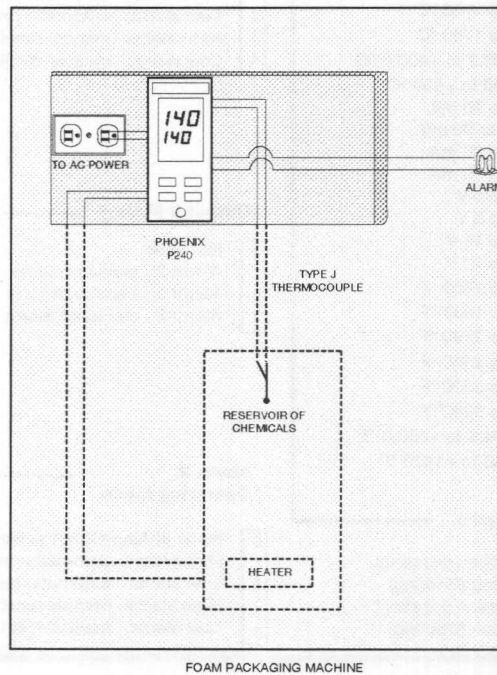
A design engineer needs a temperature controller for the company's proposed new foam packaging machine. The chemicals used to produce the foam must be heated to 140°F. The controller must also trigger an alarm if the temperature falls below 120°F or rises above 160°F. Safety Lock is desired so that the parameters cannot be changed without a password once the packaging machine is assembled and shipped.

A Phoenix P240-0-L-0-2-1-0-0-0-0-0-1 will satisfy the design engineer's requirements: Type J T/C input with a range of 0 to 1830°F, relay with reverse action for heating on Output 1, band alarm for Output 2, high (outside band) alarm for the alarm operating mode, and Safety Lock with Password Protection.

The Phoenix is connected according to the wiring diagram, then FUNC is pressed to enter the Operating Parameter selection mode.

"SP" is set at 140 (°F), the desired set point temperature. "Snrt" should be changed to On, to enable SMART Tuning. "nnn" should display OFF, indicating that Safety Lock is inactive, to set the remaining parameters.

"AL1," the alarm threshold level, is set at 20, creating a band of 20 degrees on either side of the 140°F set point. The alarm will then be triggered if the temperature falls outside of this band; i.e., below 120°F or above 160°F. "HSA1" can be left at 0.1%; the temperature must deviate outside either band limit by 0.1% of the configured input range span before the alarm is deactivated, eliminating "chatter" in the alarm relay should the measured temperature bounce around one of the band limits. Pre-configured alarm masking prohibits the alarm from being tripped during start-up until the temperature has reached the set point.



"Pb," "ti," and "td" can be left at the values displayed, as SMART Tuning will automatically adjust these parameters.

"CY1" is set at 15, indicating that one output on and off cycle for the heating output lasts for 15 seconds. The next parameter to adjust is "OLH," which can be set at 50. This will limit the heating output to being on only 50% of each 15-second cycle during Soft Start, allowing the chemicals to warm up gradually to 140°F.

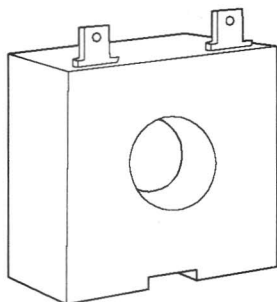
At this point, press FUNC again until "nnn" appears in the lower display. Set "nnn" to On to activate Safety Lock.

After waiting for 30 seconds, the P240 will exit Operating Parameter selection mode and SMART Tuning begins.

Ordering Information

Model P240 4 Digit		Power Supply 0 100-240 VAC 24V AC/DC available on special order	
Input 0 Type L T/C 0 to 400.0 °C 1 Type L T/C 0 to 900 °C 2 Type J T/C 0 to 400.0 °C 3 Type J T/C 0 to 1000 °C 4 Type K T/C 0 to 400.0 °C 5 Type K T/C 0 to 1200 °C 6 Type N T/C 0 to 1400 °C 7 Type R T/C 0 to 1760 °C 8 Type S T/C 0 to 1760 °C 9 RTD Pt100 -199.9 to +400.0 °C A RTD Pt100 -200 to +800 °C B mV 0 to 60 mV C mV 12 to 60 mV D mA 0 to 20 mA E mA 4 to 20 mA F V 0 to 5 V G V 1 to 5 V H V 0 to 10 V J V 2 to 10 V K Type L T/C 0 to 1650 °F L Type J T/C 0 to 1830 °F M Type K T/C 0 to 2190 °F N Type N T/C 0 to 2550 °F P Type R T/C 0 to 3200 °F Q Type S T/C 0 to 3200 °F R RTD Pt100 -199.9 to +400.0 °F S RTD Pt100 -330 to +1470 °F		Output 2 (Relay) 0 Not used 1 Alarm 1: process alarm 2 Alarm 1: band alarm 3 Alarm 1: deviation alarm 4 Cooling output: air * 5 Cooling output: oil * 6 Cooling output: H2O * * requires Output 1 to be heating output	
Output 1 (Main Output) 0 Relay: reverse action (Heating) 1 Relay: direct action (Cooling) 2 SSR: reverse action (Heating) 3 SSR: direct action (Cooling)		Alarm 1 Operating Mode 0 None (if Alarm 1 not selected) 1 High alarm: automatic reset 2 Low alarm: automatic reset 3 High alarm: manual reset 4 Low alarm: manual reset	
Alarm 2 Operating Mode 0 None (if Alarm 2 not selected) 1 High alarm: automatic reset 2 Low alarm: automatic reset 3 High alarm: manual reset 4 Low alarm: manual reset		Alarm 3 Operating Mode 0 None (if Alarm 3 not selected) 1 High alarm: automatic reset 2 Low alarm: automatic reset 3 High alarm: manual reset 4 Low alarm: manual reset	
Primary Current for Transformer 0 None (if Heater Break Detection not selected) 1 10 Amp AC 2 25 Amp AC 3 50 Amp AC 4 100 Amp AC NOTE: Current Transformer sold separately		Safety Lock (Parameter Protection) 0 No parameter protection 1 Password protection	
Options 0 None 1 Heater Break Detection + Alarm 3: process alarm 2 Heater Break Detection + Alarm 3: band alarm 3 Heater Break Detection + Alarm 3: deviation alarm			

Accessories

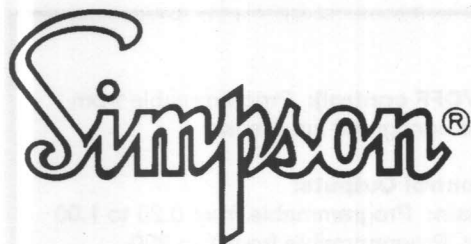


The PCTR series Current Transformer should be ordered for Phoenix PID controllers with the Heater Break Detection option. This Current Transformer measures the Output 1 current and sends a signal to the Phoenix if that load current drops below the pre-programmed threshold. Spade terminals permit easy connection. Leads are not included.

Catalog Number	Primary (ACA)	Secondary (ACmA)	Accuracy@ 0.2VA Pmax
PCTR10	10	50	2.3 %
PCTR25	25	50	2.0 %
PCTR50	50	50	1.0 %
PCTR100	100	50	1.0 %

Nominal Operating Frequency: 50 to 60Hz

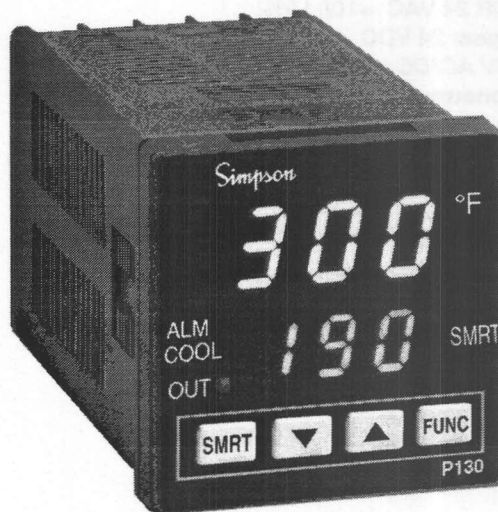
NOTE: Thermocouples and Temperature Transmitters compatible with the Phoenix PID controllers are also available from Simpson. Contact factory for more information.



Temperature Controllers

Phoenix P130 PID Controller 3 Digit 1/16 DIN

- Easily Programmed From the Front Panel
- SMART Auto-tuning for Automatic Adjustment and Continuous Tuning of Optimum Control Parameters
- Full PID or On/Off Control
- Dual Display: Both Measurement and Set Point Values
- Choice of T/C or RTD inputs (J, K, L, N, or RTD Pt100)
- Two Outputs Standard
- Alarm Option: Choice of Process, Band, Deviation or Instrument Failure Indicator Alarm
- IP65 / Nema 4X Protection
- Standard Screw Terminal Connector With Safety Cover



Simpson's new Phoenix Series PID controllers offer ease of use and full PID control for a variety of thermocouple and RTD inputs. The controller can operate in the standard PID control mode for both heating and cooling, with on-demand SMART Tuning to automatically set the optimum PID parameters. The P, I, and D actions are also manually adjustable over a wide range. On/Off control operation is keypad-selectable.

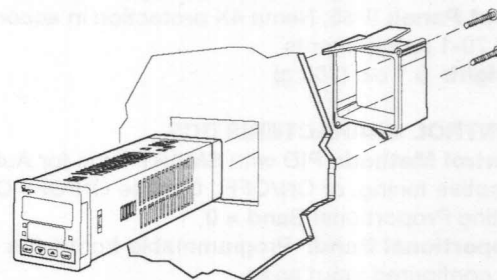
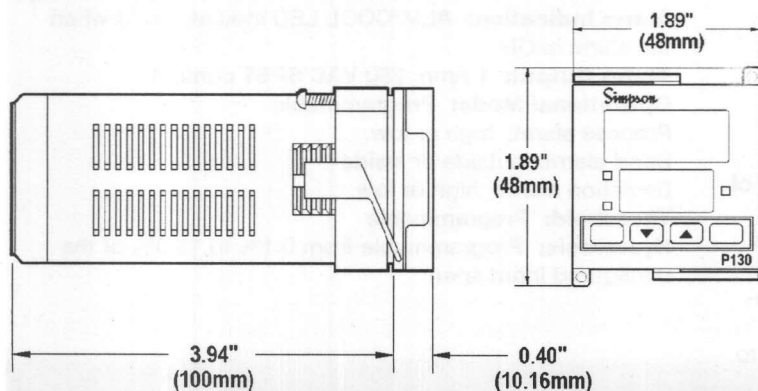
Two outputs are standard on the P130, allowing for both heating and cooling control. The second output can be configured as an alarm in lieu of a cooling

output. A process, band, or deviation alarm or an instrument failure indicator may be selected. The safety lock feature provides password protection.

Model P130 features a dual, 3-digit LED display with LED indicators for output and alarm status. Screw terminal connectors are standard for easy wiring, and a rear safety cover is included.

The model P130 fits the standard 1/16 DIN panel cutout (45mm X 45mm) and requires only 100mm depth behind the panel. The front panel offers IP65/Nema 4X protection.

Installation and Panel Cutout



Mounting Instructions

Insert the Phoenix into the panel cutout through the front. From behind the panel, slide the white mounting bracket over the Phoenix, gently pulling the tabs out to move the bracket. The mounting screws and tabs should be on the top and bottom of the controller. Push the bracket forward until it is flush with the panel, then tighten the mounting screws to hold the Phoenix in place.

Specifications

DISPLAY

Type: Dual 3-digit LED

Upper (yellow-green): Process measurement value

Lower (orange): Set point value

POWER REQUIREMENTS

AC Voltages: 100 to 240 VAC +10/-15%, 50/60 Hz
OR 24 VAC +10/-15%

DC Voltages: 24 VDC +10/-15%

NOTE: 24V AC/DC is available on special order.

Power Consumption: 5 VA

ACCURACY @ 25°C

±0.3% of full scale ±1 digit

ENVIRONMENTAL

Operating Temperature: 0 to 50°C

Storage Temperature: -30 to 70°C

Relative Humidity: 20 to 85% non-condensing

Warm-up Time: None required

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: 120 dB, 50/60 Hz

ANALOG TO DIGITAL CONVERSION

Technique: Dual slope integration

Sampling Time: 500ms typical

INPUT: THERMOCOUPLE

Types: J, K, L, N (either °C or °F)

Cold Junction Compensation: automatic from 0 to 50°C ambient temperature

Input Impedance: 100Ω max.

Resolution: 1°C; 1°F

INPUT: RTD (.00385 alpha)

Type: Pt100 3-wire (either °C or °F)

Line Resistance: < 4Ω per wire

Resolution: 0.1° or 1°C; 1°F

MECHANICAL

Bezel: 1.9" x 1.9" (48 x 48 mm)

Depth: 3.9" (100 mm)

Panel Cut-out: 1.8" x 1.8" (45 x 45 mm 1/16 DIN)

Case Material: grey ABS

Front Panel: IP65, Nema 4X protection in accordance with CEI 70-1 requirements

Weight: 5.1 oz. (160 g)

CONTROL CHARACTERISTICS

Control Method: PID with SMART Tune for Auto and Adaptive tuning, or ON/OFF. Choose ON/OFF Control by setting Proportional Band = 0

Proportional Band: Programmable from 1.0% to 99.9% of the configured input span

Integral Time: Programmable from 1 minute 20 seconds to 20.0 minutes, or excluded

Derivative Time: Programmable from 1 second to 9 minutes 59 seconds, or excluded

Output 1 (Heating) Cycle Time: Programmable from 1 to

200 seconds

Hysteresis (for ON/OFF control): Programmable from 0.1% to 10.0% of the configured input span

In the Case of 2 Control Outputs:

Relative Cooling Gain: Programmable from 0.20 to 1.00

Cooling cycle time: Programmable from 1 to 200 seconds

Overlap/deadband: Programmable from -20% (dead-band) to +50% (overlap) of the proportional band

NOTE: These Output 2 parameters will be automatically set during configuration according to the cooling medium (air, oil, or water) selected.

CONTROL OUTPUTS

Type: One (Heating or Cooling) or Two (#1 Heating, #2 Cooling)

Direct/Reverse Action: Programmable

Output Status Indication: Red LED indicators on the front panel are lit when their respective output is in the ON condition. OUT indicates heating cycle is on, while ALM/COOL indicates cooling cycle is on.

Output Level Limiter: Programmable from 0% to 100% of the output span. Operates at start-up for programmed time to avoid thermal shock.

Relay Outputs:

Output cycle time: Programmable from 1 to 200 seconds

Heating Output: 3 Amp, 250 VAC SPDT contact

Cooling Output: 1 Amp, 250 VAC SPST contact

Logic Voltage for SSR Driver (Output 1 only):

Logic Level 0: Vout < 0.5 VDC

Logic Level 1:

14 VDC ± 20% @ 20 mA max.

24 VDC ± 20% @ 1 mA max.

OUTPUT POWER OFF FUNCTION

This function allows the instrument to operate as an indicator by disabling the control output, removing power from the controlled load. It is therefore possible to continue monitoring the process variable even if the load is off.

ALARM

An Alarm may be selected in lieu of Output 2.

Alarm Functions: Process alarm, Band alarm, Deviation alarm, or Instrument failure indicator

Alarm Reset: Automatic reset

Masking: Alarm can be configured as masked, to avoid false alarm indication at start-up or after a set point change

Alarm Indication: ALM/COOL LED indicator is lit when the alarm is ON

Alarm Output: 1 Amp, 250 VAC SPST contact

Operational Mode: Programmable

Process alarm: high or low

Band alarm: outside or inside

Deviation alarm: high or low

Threshold: Programmable

Hysteresis: Programmable from 0.1% to 10.0% of the configured input span

Control Action

ON / OFF CONTROL

This is the simplest form of temperature control. An ON/OFF controller switches the output when the temperature crosses the set point. For heating applications, the output is ON (at 100%) below the set point and OFF (at 0%) above the set point; the opposite is true for cooling applications.

If the ON and OFF points were actually the same, the relay would cycle rapidly as the process temperature crossed the set point. To prevent this "chatter," a dead-band, or Hysteresis, is added to the control operation. This Hysteresis sets a band around the set point that the temperature must cross before the output can be switched on or off again, eliminating rapid cycling.

The Phoenix can be configured for ON/OFF control by entering the Operation Parameter mode and setting the Proportional Band (Pb) = 0.

PID CONTROL

PID Control adds Proportional, Integral and Derivative action to ON/OFF Control in order to more closely regulate the process temperature. It is recommended for processes subject to wide temperature cycling or sudden changes in process temperature or load.

Proportional Action adjusts the output as soon as the process temperature enters a selected **Proportional Band** around the set point. The output is controlled proportionally to the difference between the set point and the actual process temperature. As the measured value approaches the set point, the output level gradually decreases until the temperature stabilizes.

In reality, Proportional Action usually brings the process temperature very close but not exactly to the set point. This difference is called "offset".

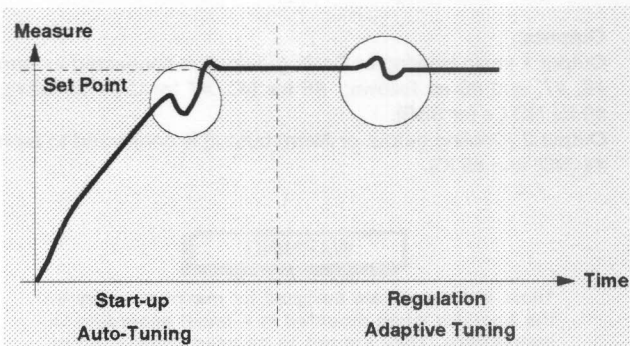
Integral Action automatically corrects this offset by measuring the difference between the set point and the measured value and then shifting the Proportional Band accordingly. Integral Action is expressed in minutes and seconds, representing the time needed to reset the Proportional Band. For this reason, Integral Action is often referred to as "reset".

Derivative Action enables the controller to react to rapid changes in the process temperature -- for example, a sudden rush of cooler material into the flow. The output is adjusted in proportion to the rate of change in the process temperature over the set derivative time. Derivative Action is therefore often referred to as "rate".

With the Simpson Phoenix PID controller, the PID values can be selected by the user in the Operation parameter setting mode. However, SMART Tuning will monitor the process and automatically set the optimum PID parameters.

SMART Tuning

Simpson's Phoenix PID controller is equipped with a SMART self-tuning algorithm. SMART Tuning enables the controller to automatically adjust the PID parameters to the optimum levels according to the process conditions.



At Start-Up

SMART implements auto-tuning function to calculate optimum PID values for best approach to set point.

During Regulation

SMART continually monitors the process and updates the PID parameters as the Phoenix adapts to changes in either set point or load.

To enable SMART Tuning, make sure the instrument is in normal display mode, then press SMART. The SMART LED indicator will be flashing during auto-tuning and lit during continuous adaptive tuning.

NOTE: While the SMART Tuning function is enabled, the control parameters (Pb, ti, td, rC) may be displayed but not modified.

To disable SMART Tuning, press SMART again. The SMART LED indicator will turn off. The control parameters may be modified when SMART Tuning is disabled.

Soft Start

Simpson's Phoenix PID controller is equipped with a Soft Start function to gradually warm up the process temperature. Soft Start takes effect immediately at start-up, limiting the output power level in order to avoid thermal shock.

Output during Soft Start is determined according to the Output High Limit (OLH) and Output 1 Cycle Time (C) operating parameters. OLH sets the percentage of the cycle time that the output power will be ON during Soft Start. For example, if C = 15 seconds and OLH was set at 50%, then the heating output would only be ON for a maximum of 7.5 seconds during Soft Start.

Wiring Diagram

Supply Power: Connect the power (100-240 VAC or 24V AC/DC) to terminals #9 and #10.

Input Signal:

Thermocouples are connected to terminals #2 and #3.
RTDs are connected to terminals #1, #2, and #3.

Outputs:

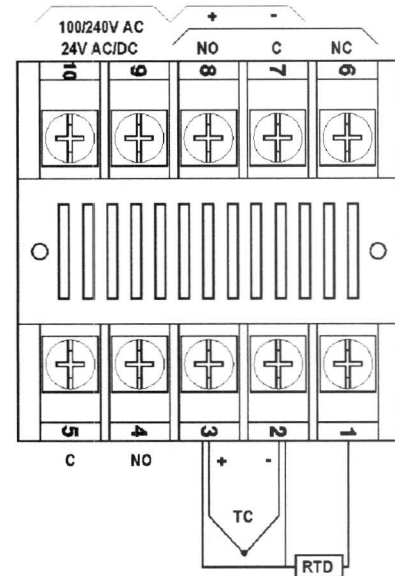
Output 1 (main Heating or Cooling output) is connected to terminals #6, #7, and #8 as follows: #6 for NC, #7 for C (- for SSR), and #8 for NO (+ for SSR).
Output 2 (Cooling output or Alarm output) is connected to terminals #4 (NO) and #5 (C).

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

CAUTION

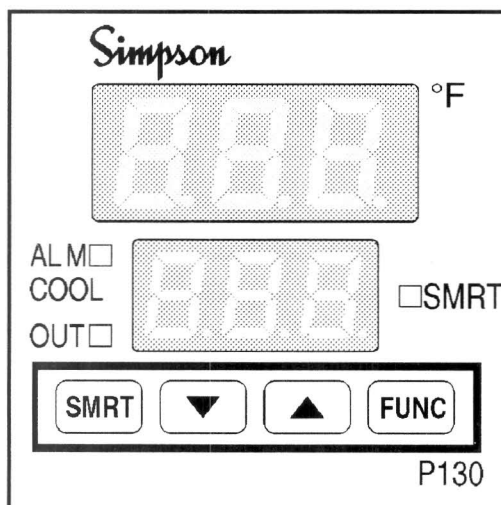
The Solid State Relay option (SSR) is a logic voltage for a SSR driver. Be sure to connect to a SSR driver and not directly to the load.



CAUTION

Before switching the instrument on, make sure the supply voltage is within the range required as indicated on the hook-up label affixed to the instrument.

P130 Display



DISPLAY

Upper Display: Process measurement value (yellow-green)
Lower Display: Set point value (orange)

KEYPAD DESCRIPTION

- Decreases the selected parameter value.
- Increases the selected parameter value.
- FUNC** Displays parameters in sequence and enters new values.
- SMRT** Turns SMART Tuning on or off.
- + **FUNC** Enables/Disables the OUTPUT POWER OFF function.

LED INDICATORS

- SMRT** Indicates SMART Tuning function is active. Flashes during auto-tuning. Lit during adaptive tuning.
- OUT** Indicates OUTPUT 1 (Main Output) is ON.
- ALM/COOL** Indicates OUTPUT 2 is ON, if Cooling Output is selected, OR Indicates Alarm is ON, if Alarm is selected.

Operation

SIMPLE SET-UP

Starting PID Control can be accomplished simply by connecting the instrument, selecting the desired set point and alarm values, and turning on SMART Tuning. Just follow these easy steps:

- 1) Install the Phoenix P130 in the panel and connect wiring according to diagram. Apply power.
- 2) Select the set point and alarm values (if any). The parameter code will appear in the lower display, and the parameter value or status will be shown in the upper display.

Press the FUNC button. "SP" (set point) will appear. Use the ▲ or ▼ buttons to reach the desired set point value*.

Press FUNC again to scroll past "nnn" (the Safety Lock status).

If no Alarm has been selected, proceed to step 3 now. To set the Alarm threshold, continue below.

"AL" will appear next if an Alarm has been ordered. Use ▲ or ▼ to set the desired Alarm value. Press FUNC, and "hSA" (Alarm Hysteresis) will appear. Use ▲ or ▼ to enter the Hysteresis value*, if desired, then press FUNC.

- 3) When finished, do not press any buttons for 30 seconds. The instrument will then exit Operating Parameter mode and begin process control.

OPERATING PARAMETERS

For those who wish to manually enter the PID parameters or program the control outputs, following is a complete list of the Operating Parameters, described in the order in which they appear.

To enter the Operating Parameter mode, press FUNC and release. When setting the Operating Parameter values, the lower display will show the parameter name, and the upper display will indicate the value of the parameter or whether it is ON or OFF. Use the ▲ or ▼ keys to select the desired value or ON/OFF status. To enter the value or status and move to the next parameter, press the FUNC button. When finished, wait 30 seconds for the instrument to return to control mode.

NOTE: Some of the following parameters may be skipped, depending on the instrument configuration. Factory default values, if any, are listed in () parentheses.

SP	Set point, expressed in engineering units. *
nnn	Safety Lock parameter protection. On indicates that the parameters are locked, except for set point and manual reset. OFF indicates that the parameters are unlocked. To change the ON/OFF status, enter the password 853. <i>Available only when Password Protection has been selected.</i>
AL	Alarm Threshold, expressed in engineering units. This is the value at which the Alarm will be activated.
hSA	Alarm Hysteresis, expressed as a percentage of the configured input range span, from 0.1% to 10.0%. Active when process is coming out of alarm condition. *
Pb	Proportional Band, expressed as a percentage of the configured input range span, from 1.0 to 99.9. The Phoenix PID tuning logic operates within this band to adjust the output until the temperature just reaches the desired set point. (4.0) *
hS	Hysteresis for ON/OFF control action only, expressed as a percentage of the configured input range span, from 0.1% to 10.0%. *
ti	Integral Time, expressed in minutes and seconds. Programmable from 1.20 to 20.0. This represents the time required to reset the Proportional Band in order to bring the temperature exactly to the set point. (4.0)

td	Derivative Time, expressed in minutes and seconds. Programmable from 0.01 to 9.59. This represents the rate required to overcome deadband and shift the Proportional Band in order to compensate for a sudden change in process temperature. (1.00)
C	OUTPUT 1 (Heating) Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 1. Programmable from 1 to 200 seconds. (20)
C2	OUTPUT 2 (Cooling) Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 2. Programmable from 1 to 200 seconds. (10)
rC	Relative Cooling Gain, in minutes and seconds from 0.20 to 1.00. This is the relative gain for OUTPUT 2 when used as a Cooling Output. (1.00)
OLP	Deadband or Overlap between the Heating and Cooling Outputs, programmable from -20% to +50% of the Proportional Band. (0)
rL	Set point low limit, expressed in engineering units. (0) *
rH	Set point high limit, expressed in engineering units. (400) *
OLH	Output high limit, expressed in % of the output. Programmable from 0% to 100% of heating output. This limit is based on the amount of time OUTPUT 1 is ON vs. the Cycle 1 time. (100)
tOL	Time duration of the output power limit, from 1 to 100 minutes. This is the amount of time OLH is active. When tOL = Infinite, OLH is always active. (Inf)

* NOTE: To achieve optimum PID performance, the actual input range span is narrower than listed: T/C °F input = 600°; T/C °C = 500°; RTD °F = 600°; RTD °C = 500°. Hysteresis functions, Proportional Band, and Set Point limits are determined by this span. If this configured input range span is too narrow for one or more of these desired parameter settings, contact Simpson Technical Support for adjustment instructions.

Operation cont.

NORMAL DISPLAY MODE

In normal display mode, the upper display of the Phoenix indicates the measured value, while the lower display shows the set point value.

DIRECT ACCESS TO SET POINT

It is possible to change the set point without going through the entire Operating Parameter selection.

Make sure the Phoenix is in normal display mode (no parameters are being modified). Press ▲ or ▼ and hold for at least three seconds. The set point value in the lower display will begin changing.

Press ▲ or ▼ until the desired set point value is reached. This new set point value will take effect after a three-second delay with no buttons being pressed.

NOTE: To cancel Direct Access, press FUNC. The instrument will revert to normal display mode and retain the original set point.

OUTPUT POWER OFF FUNCTION

The Phoenix P130 can be operated as an indicator by turning off the control output power. To disable the output power, make sure the instrument is in normal display mode, then press ▲ and FUNC simultaneously for at least three seconds.

The P130 will now function as an indicator. "OFF" will appear in the lower display. Alarms, if any, will be in non-alarm condition.

To restore the control output power, press ▲ and FUNC simultaneously for at least three seconds.

INSTRUMENT FAILURE INDICATOR

This feature allows the Phoenix P130 to detect measurement errors. In the case of an out-of-range or burnout condition, or an internal measurement error, the ALM LED indicator on the front panel will be lit.

ERROR MESSAGES

The Phoenix PID controller performs self-diagnostic testing and indicates on the display any errors detected.

Overrange: 000

Underrange: _00

Burnout Conditions: will be shown as an overrange condition.

Coded Messages

When other errors are detected, "Err" appears in the lower display and the corresponding error code (e.g. "100," "200") shows in the upper display.

NOTE: Contact Simpson Technical Support at (708) 697-2260 for instructions on how to correct the error condition or to return the instrument for repair.

CONFIGURATION

The configuration parameters of this instrument have been programmed according to the part number ordered. If the original application changes, the instrument can be reconfigured by Simpson or by an authorized Phoenix modification center. Call Technical Support at (708) 697-2260 for more details.

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

Application Example #1

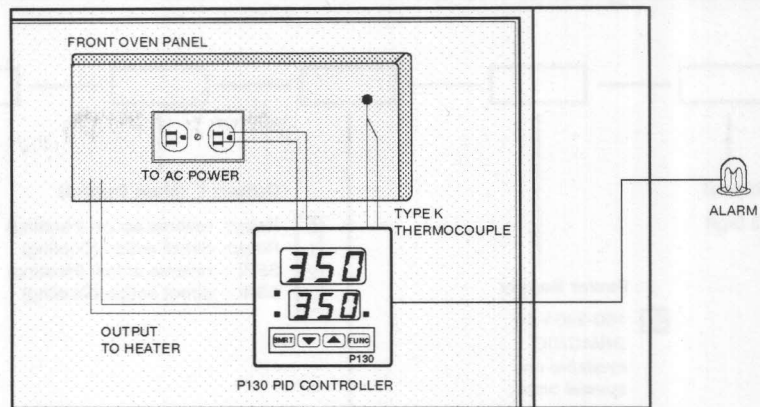
A process engineer needs to install a temperature controller in an oven for a food processing plant. The controller needs to maintain the oven temperature at 350°F. An alarm must sound if the temperature exceeds 380°F. In addition, the engineer wants to include password protection and set point limits, so that the set point may be modified only by qualified plant personnel.

A Phoenix P130-0-8-0-1-1 will satisfy these requirements: Type K T/C input with a range of 0 to 999°F, relay with reverse action for heating on Output 1, process alarm for Output 2, high alarm for the alarm operating mode, and password protection to prohibit accidental tampering with the process.

The Phoenix is connected according to the wiring diagram, then FUNC is pressed to enter the Operating Parameter selection mode.

"SP" is set at 350 (°F), the desired set point temperature. "nnn" should display OFF, indicating that Safety Lock is inactive, to set the remaining parameters.

"AL" (the alarm threshold) appears next and is set at 380 (°F), the temperature above which the alarm is to be activated. "hSA" can be left at 0.1%; the temperature must then drop below 380°F by 0.1%



of the configured input range span before the alarm is deactivated, eliminating "chatter" in the alarm relay should the measured value bounce around the alarm threshold. Pre-configured alarm masking prohibits the alarm from being tripped during start-up until the temperature has reached the set point.

"Pb", "ti", and "td" can be left at the values displayed, as SMART Tuning will automatically adjust these parameters.

"C" is set at 15, indicating that one output on and off cycle for the main output lasts for 15 seconds.

"rL" and "rH" limit the range in which the set point can be set. Entering 340 for "rL"

and 360 for "rH" will make sure that, should someone accidentally access the set point, it cannot be set below 340°F or above 360°F.

"OLH" and "tOL" can be left at the values displayed. In this application, there is no need for a gradual approach to the set point.

At this point, press FUNC again until "nnn" appears in the lower display. Change "nnn" to On to activate Safety Lock.

After waiting for 30 seconds, the P130 will exit Operating Parameter selection mode and SMART tuning begins.

Application Example #2

A lab technician needs to replace the controller in the lab's environmental chamber. The new controller must be able to maintain the temperature in the chamber at 10°C and trigger an alarm if the temperature rises above 25°C. The control output needs to be a solid state relay contact, and the controller must accept an RTD Pt100 signal input. In addition, the technician wants password protection to limit access to the operating parameters.

A Phoenix P130-0-5-3-1-1 will fulfill the technician's requirements: RTD Pt100 input with a range of -19.9 to +99.9 °C, SSR contact with direct action for cooling on Output 1, process alarm for Output 2, high alarm for the alarm operating mode, and Safety Lock "On" to restrict access to set point only without the password.

The Phoenix is connected according to the wiring diagram, then FUNC is pressed to enter the Operating Parameter selection mode.

"SP", the set point temperature, is set at 10.0 (°C). "nnn" should display OFF, indicating that Safety Lock is inactive, to set the remaining parameters.

"AL" (the alarm threshold) is set at 25 (°C),

the temperature above which the alarm is to be activated. "hSA" (hysteresis) should be left at 0.1%; the temperature then must drop below 10.0 by 0.1% of the configured input range span before deactivating the alarm, eliminating "chatter" in the alarm relay should the measured value bounce around the alarm threshold.

"Pb", "ti", and "td" can be left at the values displayed. SMART Tuning will automatically adjust these parameters.

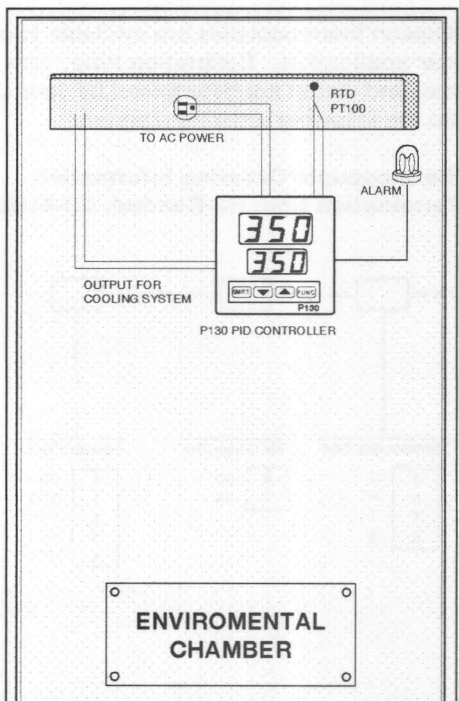
"C" is set at 20, indicating that one cooling output on and off cycle lasts for 20 seconds.

Entering 8.0 for "rL" and 12.0 for "rH" protects the process by limiting the selection range for the set point value. Should the set point be changed, the new value must be between 8.0°C and 12.0°C.

"OLH" and "tOL" can be left at the values displayed. A gradual approach to the set point is not needed in this application.

At this point, press FUNC again until "nnn" appears in the lower display. Set "nnn" to On to activate Safety Lock.

After waiting for 30 seconds, the P130 will exit Operating Parameter selection mode and SMART Tuning begins.



Ordering Information

Model P130 3 Digit	Power Supply 0 100-240 VAC 24VAC/DC <i>available on special order.</i>	Input 0 Type L T/C 0 to 800 °C 1 Type J T/C 0 to 800 °C 2 Type K T/C 0 to 999 °C 3 Type N T/C 0 to 999 °C 4 RTD Pt100 -199 to +500 °C 5 RTD Pt100 -19.9 to +99.9 °C 6 Type L T/C 0 to 999 °F 7 Type J T/C 0 to 999 °F 8 Type K T/C 0 to 999 °F 9 Type N T/C 0 to 999 °F A RTD Pt100 -199 to +999 °F	Output 1 (Main Output) 0 Relay: reverse action (Heating) 1 Relay: direct action (Cooling) 2 SSR: reverse action (Heating) 3 SSR: direct action (Cooling)	Output 2 (Relay) Function 0 Not used 1 Alarm: process alarm 2 Alarm: band alarm 3 Alarm: deviation alarm 4 Instrument failure indicator 5 Cooling output: air * 6 Cooling output: oil * 7 Cooling output: H ₂ O * <i>* requires Output 1 to be heating output</i>	Alarm Operating Mode 0 None (if Alarm not selected) 1 High alarm 2 Low alarm	Safety Lock (Parameter Protection) 0 No parameter protection 1 Password protection
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Accessories

Simpson thermocouples are available in custom lengths per your application. Calibration type, wire gauge, insulation type, and length are determined by your specs, and entered into the following ordering diagram.

Thermocouple Ordering Information (Termination End: HJ-Beaded, CJ-Solid Bare Wire)

Thermocouple Type J J K K T T E E	Wire Gauge Size 0 20 1 24	Insulation Type 0 GB 1 GBS 2 DGW 3 FEP 4 HTB	Thermocouple Length (Indicate Number of Feet) TH
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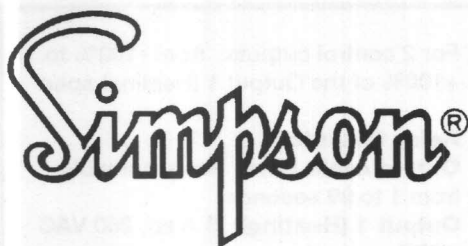
THERMOCOUPLE PROBES (QUICK DISCONNECT)

Simpson offers "Quick Disconnect" style thermocouples which include a probe and an ANSI color coded jack and plug. Each 12 inch thermocouple probe is compacted with MgO insulation, with 316 stainless steel and 0.188 inch diameter outer sheath. Extra plugs and jacks are sold separately. See the table below for ordering information.

THERMOCOUPLE PROBES (48 INCH LEAD WIRE)

Simpson's transition joint thermocouple probes are constructed with MgO insulation. The probe includes 48" of Teflon® coated thermocouple wire and stripped leads.

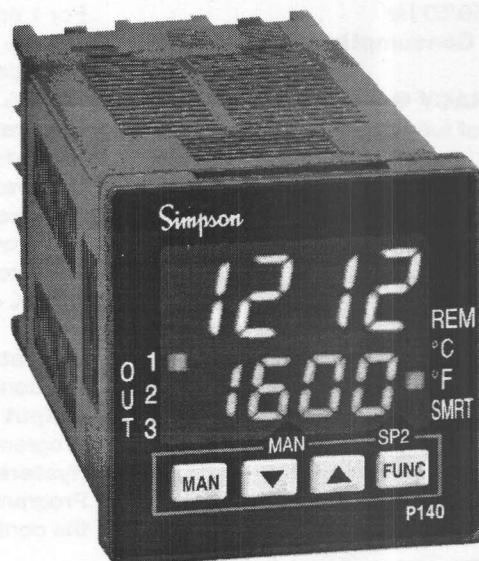
Type	Catalog Numbers				
	ANSI Color Code	Quick Disconnect	48 Inch Lead Wire	Plug Only	Jack Only
J	Black	21238	21242	21245	21249
K	Yellow	21239	21243	21246	21250
T	Blue	21240	-----	21247	21251
E	Purple	21241	-----	21248	21252
RTD	-----	-----	21244	-----	-----



Temperature Controllers

Phoenix P140 PID Controller 4 Digit 1/16 DIN

- Easily Programmed From the Front Panel
- SMART Auto-tuning for Automatic Adjustment and Continuous Tuning of Optimum Control Parameters
- Full PID or On/Off Control
- Dual Display: Both Measurement and Set Point Values
- Choice of T/C, RTD or Linear inputs (J, K, L, N, R, S, RTD Pt100, mA, mV, or V)
- Up to 2 Independent Alarms With Choice of Process, Band, or Deviation Alarms
- Automatic or Manual Reset of Alarm Condition
- Standard Screw Terminal Connector With Safety Cover
- Optional Heater Break Detection



Simpson's new Phoenix Series PID controllers offer ease of use and full PID control for a variety of thermocouple, RTD, or linear inputs. The controller can operate in the standard PID control mode for both heating and cooling, with on-demand SMART Tuning to automatically set the optimum PID parameters. The P, I, and D actions are also manually adjustable over a wide range. On/Off control operation is key-pad-selectable.

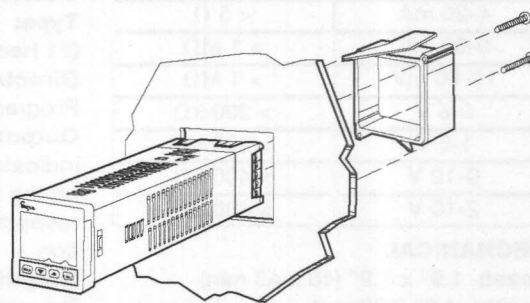
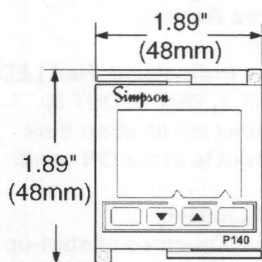
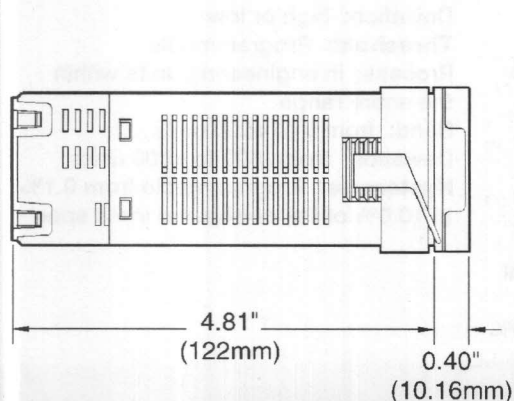
Two outputs are standard on the P140, allowing for both heating and cooling control. Up to two alarms are available and can be configured as process,

band, or deviation alarms with automatic or manual reset. The safety lock feature provides password protection.

Model P140 features a dual, 4-digit LED display with LED indicators for output and alarm status. Screw terminal connectors are standard for easy wiring, and a rear safety cover is included.

The model P140 fits the standard 1/16 DIN panel cutout (45mm X 45mm) and requires only 122mm depth behind the panel. The front panel offers IP65/Nema 4X protection.

Installation and Panel Cutout



Mounting Instructions

Insert the Phoenix into the panel cutout through the front. From behind the panel, slide the white mounting bracket over the Phoenix, gently pulling the tabs out to move the bracket. The mounting screws and tabs should be on the top and bottom of the controller. Push the bracket forward until it is flush with the panel, then tighten the mounting screws to hold the Phoenix in place.

Specifications

DISPLAY

Type: Dual 4-digit LED
Upper (yellow-green): Process measurement value
Lower (orange): Set point value

POWER REQUIREMENTS

AC Voltages: 100 to 240 VAC +10/-15%, 50/60 Hz
Power Consumption: 8 VA max.

ACCURACY @ 25°C

±0.2% of full scale

ENVIRONMENTAL

Operating Temperature: 0 to 50°C
Storage Temperature: -20 to 70°C
Relative Humidity: 20 to 85% non-condensing
Warm-up Time: None required

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz
CMRR: 120 dB, 50/60 Hz

ANALOG TO DIGITAL CONVERSION

Technique: Dual slope integration
Sampling Time: 250ms (Linear inputs)
500ms (T/C and RTD inputs)

INPUT: THERMOCOUPLE

Types: J, K, L, N, R, S (either °C or °F)
Cold Junction Compensation: automatic from 0 to 50°C ambient temp.
Input Impedance: > 1 MΩ
Resolution: 0.1° or 1° C; 1°F

INPUT: RTD (.00385 alpha)

Type: Pt100 3-wire (either °C or °F)
Line Resistance: Max 20Ω/wire with no appreciable error
Resolution: 0.1° or 1° C; 0.1° or 1°F

INPUT: LINEAR (mA, mV, V)

Input	Impedance
0-20 mA	< 5 Ω
4-20 mA	< 5 Ω
0-60 mV	> 1 MΩ
12-60 mV	> 1 MΩ
0-5 V	> 200 kΩ
1-5 V	> 200 kΩ
0-10 V	> 400 kΩ
2-10 V	> 400 kΩ

MECHANICAL

Bezel: 1.9" x 1.9" (48 x 48 mm)
Depth: 4.8" (122mm)
Panel Cut-out: 1.8" x 1.8" (45 x 45mm 1/16 DIN)
Case Material: grey ABS
Front Panel: IP65, Nema 4X protection in accordance with CEI 70-1 req.

Weight: 0.5 lb (250 g) max.

CONTROL CHARACTERISTICS

Control Method: PID with SMART Tune for Auto and Adaptive tuning, or ON/OFF. Choose ON/OFF Control by setting Proportional Band = 0
Proportional Band: Programmable
For 1 control output: from 1.0% to 100.0% of the configured input span
For 2 control outputs: from 1.5% to 100.0% of the configured input span
Integral Time: Programmable from 20 seconds to 20 minutes, or excluded
Integral Pre-load: Programmable
For 1 control output: from 0% to 100% of the output range
For 2 control outputs: from -100% to +100% of the heating/cooling output range
Derivative Time: Programmable from 1 second to 10 minutes, or excluded
Output 1 (Heating) Cycle Time: Programmable from 1 to 200 seconds
Hysteresis (for ON/OFF control): Programmable from 0.1% to 10.0% of the configured input span

In the Case of 2 Control Outputs:

Relative Cooling Gain:

Programmable from 0.20 to 1.00

Cooling cycle time: Programmable from 1 to 200 seconds

Overlap/deadband: Programmable from -20% (deadband) to +50% (overlap) of the proportional band

NOTE: These Output 2 parameters will be automatically set during configuration according to the cooling medium (air, oil, or water) selected.

Auto/Manual Mode: Selectable from front panel

Auto/Manual Transfer: Bumpless method

CONTROL OUTPUTS

Type: One (Heating or Cooling) or Two (#1 Heating, #2 Cooling)

Direct/Reverse Action: Programmable

Output Status Indication: Red LED indicators (OUT 1, OUT 2, OUT 3) on the front panel are lit when their respective output is in the ON condition

Output Level Limiter:

Programmable. Operates at start-up for programmed time to avoid thermal shock.

For 1 control output: from 0% to 100% of the output span

For 2 control outputs: from -100% to +100% of the Output 1 (Heating) span

Relay Outputs:

Output cycle time: Programmable from 1 to 99 seconds

Output 1 (Heating): 3 Amp, 250 VAC SPDT contact

Output 2 (Cooling): 2 Amp, 250 VAC SPST contact

Logic Voltage for SSR Driver

(Output 1 only):

Logic Level 0: Vout < 0.5 VDC

Logic Level 1:

14 VDC ± 20% @ 17 mA max.

24 VDC ± 20% @ 1 mA max.

Output Safety Value: When the instrument detects an out-of-range or a burn-out condition, it can force the output to a programmed safety value

OUTPUT POWER OFF FUNCTION

This function allows the instrument to operate as an indicator by disabling the control output, removing power from the controlled load. It is therefore possible to continue monitoring the process variable even if the load is off.

ALARMS

Alarm 1 may be selected in lieu of Output 2. An Alarm 2 is available as an option.

Alarm Functions: Process alarm, Band alarm, or Deviation alarm

Alarm Reset: Either Automatic or Manual reset

Masking: Each Alarm can be configured as masked, to avoid false alarm indication at start-up or after a set point change

Alarm Indication: LED indicators are lit when the respective alarm is ON

Alarm Output: 2 Amp, 250 VAC SPST contact

Operational Mode: Programmable
Process: high or low

Band: outside or inside band

Deviation: high or low

Threshold: Programmable

Process: in engineering units within the entire range

Band: from 0 to +500 units

Deviation: from -500 to +500 units

Hysteresis: Programmable from 0.1% to 10.0% of the configured input span

Control Action

ON / OFF CONTROL

This is the simplest form of temperature control. An ON/OFF controller switches the output when the temperature crosses the set point. For heating applications, the output is ON (at 100%) below the set point and OFF (at 0%) above the set point; the opposite is true for cooling applications.

If the ON and OFF points were actually the same, the relay would cycle rapidly as the process temperature crossed the set point. To prevent this "chatter," a dead-band, or Hysteresis, is added to the control operation. This Hysteresis sets a band around the set point that the temperature must cross before the output can be switched on or off again, eliminating rapid cycling.

The Phoenix can be configured for ON/OFF control by entering the Operation Parameter mode and setting the Proportional Band (Pb) = 0.

PID CONTROL

PID Control adds Proportional, Integral and Derivative action to ON/OFF Control in order to more closely regulate the process temperature. It is recommended for processes subject to wide temperature cycling or sudden changes in process temperature or load.

Proportional Action adjusts the output as soon as the process temperature enters a selected **Proportional Band** around the set point. The output is controlled proportionally to the difference between the set point and the actual process temperature. As the measured value approaches the set point, the output level gradually decreases until the temperature stabilizes.

In reality, Proportional Action usually brings the process temperature very close but not exactly to the set point. This difference is called "offset".

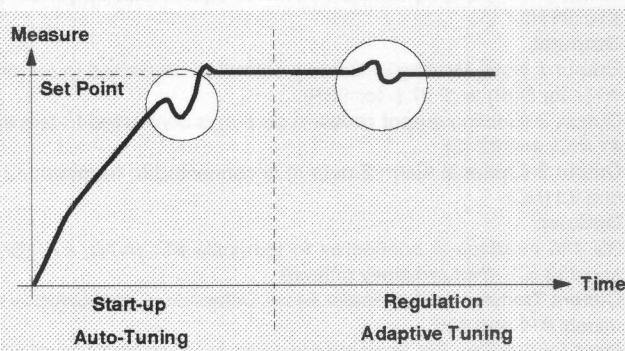
Integral Action automatically corrects this offset by measuring the difference between the set point and the measured value and then shifting the Proportional Band accordingly. Integral Action is expressed in minutes and seconds, representing the time needed to reset the Proportional Band. For this reason, Integral Action is often referred to as "reset".

Derivative Action enables the controller to react to rapid changes in the process temperature -- for example, a sudden rush of cooler material into the flow. The output is adjusted in proportion to the rate of change in the process temperature over the set derivative time. Derivative Action is therefore often referred to as "rate".

With the Simpson Phoenix PID controller, the PID values can be selected by the user in the Operation parameter setting mode. However, SMART Tuning will monitor the process and automatically set the optimum PID parameters.

SMART Tuning

Simpson's Phoenix PID controller is equipped with a SMART self-tuning algorithm. SMART Tuning enables the controller to automatically adjust the PID parameters to the optimum levels according to the process conditions.



At Start-Up

SMART implements auto-tuning function to calculate optimum PID values for best approach to set point.

During Regulation

SMART continually monitors the process and updates the PID parameters as the Phoenix adapts to changes in either set point or load.

To enable SMART Tuning, press FUNC until the "Snrt" parameter appears in the lower display. Press ▲ or ▼ until the upper display reads On, and press FUNC again to enter. The SMART LED indicator will be flashing during auto-tuning and lit during continuous adaptive tuning.

NOTE: While the SMART Tuning function is enabled, the control parameters (Pb, ti, td) may be displayed but not modified.

To disable SMART Tuning, press FUNC until the "Snrt" parameter appears in the lower display. Press ▲ or ▼ until the upper display reads OFF, and press FUNC again to enter. The SMART LED indicator will turn off.

Soft Start

Simpson's Phoenix PID controller is equipped with a Soft Start function to gradually warm up the process temperature. Soft Start takes effect immediately at start-up, limiting the output power level in order to avoid thermal shock.

Output during Soft Start is determined according to the Output High Limit (OLH) and Output 1 Cycle Time (CY1) operating parameters. OLH sets the percentage of the CY1 time that the output power will be ON during Soft Start. For example, if CY1 = 15 seconds and OLH was set at 50%, then the heating output would only be ON for a maximum of 7.5 seconds during Soft Start.

Wiring Diagram

Supply Power: Connect the power (100-240 VAC) to terminals #4 and #5.

Input Signal:

Thermocouples are connected to terminals #9 and #10.

RTDs are connected to terminals #8, #9, and #10.

Linear (mA, mV, V) inputs are connected to terminals #9 (IN LO) and #10 (IN HI).

Outputs:

Output 1 (main Heating or Cooling output) is connected to terminals #6 (+ for SSR) and #7 (- for SSR).

Output 2 (Cooling output or Alarm output) is connected to terminals #1 (NO) and #2 (C).

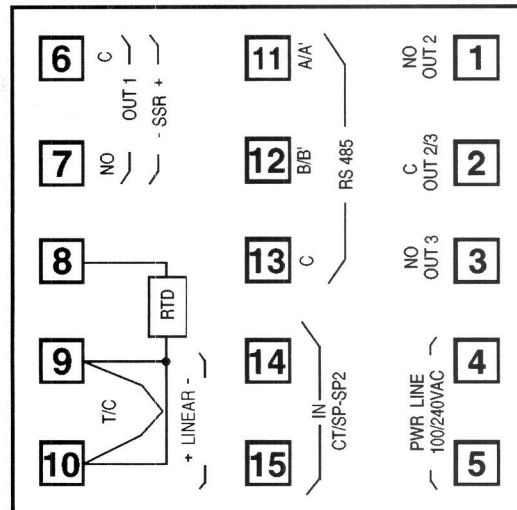
Output 3 (Optional Alarm 2 output) is connected to terminals #2 (C) and #3 (NO).

Options:

RS 485 interface is connected to terminals #11 (A/A'), #12 (B/B'), and #13 (C). (*Not presently offered*)

Current Transformer for Heater Break Detection is connected to terminals #14 and #15.

Input for Auxiliary Set Point is connected to terminals #14 and #15.



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

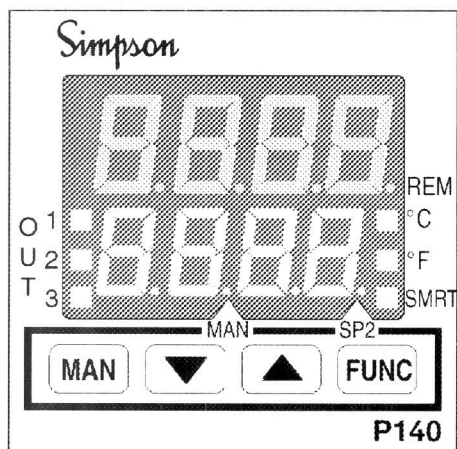
CAUTION

The Solid State Relay option (SSR) is a logic voltage for a SSR driver. Be sure to connect to a SSR driver and not directly to the load.

CAUTION

Before switching the instrument on, make sure the supply voltage is within the range required as indicated on the hook-up label affixed to the instrument.

P140 Display



DISPLAY

Upper Display: Process measurement value (yellow-green)

Lower Display: Set point value (orange)

KEYPAD DESCRIPTION

- Decreases the selected parameter value.
- Increases the selected parameter value.
- FUNC** Displays parameters in sequence and enters new values. Also displays output level and heater current.
- MAN** Switches from Auto to Manual mode.
- + **FUNC** Enables/Disables the OUTPUT POWER OFF function.

LED INDICATORS

- | | | | |
|-------------|--|----------------|--|
| REM | The decimal point at the right end of the upper display flashes to indicate that the instrument is being operated via serial link. (<i>Not presently offered</i>) | °C / °F | Indicates the selected engineering unit (for thermocouple and RTD inputs). |
| SP2 | The decimal point at the right end of the lower display flashes slowly when Auxiliary Set Point is used and flashes rapidly when a set point from the serial link is used. | OUT 1 | Indicates OUTPUT 1 (Main Output) is ON. |
| SMRT | Indicates SMART Tuning function is active. Flashes during auto-tuning. Lit during adaptive tuning. | OUT 2 | Indicates OUTPUT 2 is ON, if Cooling Output is selected, OR Indicates ALARM 1 is ON, if Alarm 1 is selected. |
| MAN | The decimal point second from the left in the lower display flashes when the instrument is in Manual mode. | OUT 3 | Indicates ALARM 2 is ON (steady light), OR Flashes slowly when heater current is lower than the programmed HBD threshold, OR Flashes rapidly when ALARM 2 and HBD are both active. |

Operation

SIMPLE SET-UP

Starting PID Control can be accomplished simply by connecting the instrument, selecting the desired set point and alarm values, and turning on SMART Tuning. Just follow these easy steps:

1) Install the Phoenix P140 in the panel and connect wiring according to diagram. Apply power.

2) Select the set point and alarm values (if any). The parameter code will appear in the lower display, and the parameter value or status will be shown in the upper display.

Press the FUNC button. "SP" (set point) will appear. Use the ▲ or ▼ buttons to reach the desired set point value*. Press FUNC again.

"Snrt" (for SMART Tuning) will then appear. Press ▲ or ▼ to switch SMART to On, then press FUNC.

Press FUNC again to scroll past "n.RST" and once more past "nnn".

"SP2" will appear next if the Auxiliary Set Point option has been ordered. Use ▲ or ▼ to select the desired second set point value*. Press FUNC.

"AL1" will appear if Alarm 1 has been ordered. Use ▲ or ▼ to set the desired Alarm 1 value. Press FUNC, and "HSA1" (Alarm 1 Hysteresis) will appear. Use ▲ or ▼ to enter the Hysteresis value*, if desired, then press FUNC. If Alarm 2 has been ordered, "AL2" will appear next. Follow the steps for AL1 to set the Alarm 2 and Hysteresis values*.

3) When finished, do not press any buttons for 30 seconds. The instrument will then exit Operating Parameter mode and begin process control.

OPERATING PARAMETERS

For those who wish to manually enter the PID parameters or program the control outputs, following is a complete list of the Operating Parameters, described in the order in which they appear.

To enter the Operating Parameter mode, press FUNC and release. When setting the Operating Parameter values, the lower display will show the parameter name, and the upper display will indicate the value of the parameter or whether it is ON or OFF. Use the ▲ or ▼ keys to select the desired value or ON/OFF status. To enter the value or status and move to the next parameter, press the FUNC button. When finished, wait 30 seconds for the instrument to return to control mode.

NOTE: Some of the following parameters may be skipped, depending on the instrument configuration. Factory default values are listed in () parentheses.

SP	Set point, expressed in engineering units. (Minimum range value)*
Snrt	SMART Tuning function status. Setting this status to On enables the SMART function. Setting it to OFF disables the SMART function.
n.RSt	Manual Reset of Alarms. If Manual Reset has been ordered for the alarms, set to On to reset the alarms. (OFF)
nnn	Safety Lock parameter protection. On indicates that the parameters are locked, except for set point and manual reset. OFF indicates that the parameters are unlocked. To change the ON/OFF status, enter the password 853. (OFF) <i>Available only when Password Protection has been selected.</i>
SP2	Auxiliary set point, expressed in engineering units. (Minimum range value)*
AL1	Alarm 1 Threshold, expressed in engineering units. This is the value at which Alarm 1 will be activated. (Process alarm: minimum range value. Band/Deviation alarm: 0)

HSA1	Alarm 1 Hysteresis, expressed as a percentage of the configured input range span. (0.1%)*
AL2	Alarm 2 Threshold, expressed in engineering units. This is the value at which Alarm 2 will be activated. (Process alarm: minimum range value. Band/Deviation alarm: 0)
HSA2	Alarm 2 Hysteresis, expressed as a percentage of the configured input range span. (0.1%)*
Pb	Proportional Band, expressed as a percentage of the configured input range span. The Phoenix PID tuning logic operates within this band to adjust the output until the temperature just reaches the desired set point. (4.0%)*
hYS	Hysteresis for ON/OFF control action only, expressed as a percentage of the configured input range span. (0.5%)*
ti	Integral Time, expressed in minutes and seconds as "mm.ss". This represents the time required to reset the Proportional Band in order to bring the temperature exactly to the set point. (4.00)
td	Derivative Time, expressed in minutes and seconds as "mm.ss". This represents the rate required to overcome deadband and shift the Proportional Band in order to compensate for a sudden change in process temperature. (1.00)
CY1	OUTPUT 1 Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 1. (15 sec. for Relay output, 4 sec. for SSR output)
CY2	OUTPUT 2 Cycle Time, in seconds. This is the amount of time required for one output power on and off cycle for OUTPUT 2. (10 sec. for Air as cooling medium, 4 sec. for Oil, 2 sec. for H2O)
rC	Relative Cooling Gain, in minutes and seconds. This is the relative gain for OUTPUT 2 when used as a Cooling Output. (1.00 for Air as cooling medium, 0.80 for Oil, 0.40 for H2O)
OLAP	Deadband or Overlap between the Heating and Cooling Outputs, expressed as a percentage of the Proportional Band. (0%)
rL	Set point low limit, expressed in engineering units. (Initial scale value)*
rH	Set point high limit, expressed in engineering units. (Full scale value)*
Grd1	Ramp applied to a positive set point change, expressed in digits per minute. This is the rate at which the process will ramp up to a new, higher set point. (Infinite)
Grd2	Ramp applied to a negative set point change, expressed in digits per minute. This is the rate at which the process will ramp down to a new, lower set point. (Infinite)
OLH	Output high limit, expressed in % of the output. This limit is based on the amount of time OUTPUT 1 is ON vs. the Cycle 1 time. (100%)
tOL	Time duration of the output power limit, in minutes. This is the amount of time OLH is active. When tOL = Infinite, OLH is always active. (Infinite)
Hbd	Threshold value for Heater Break Detection alarm, in Amperes. (50% of current transformer range)

* NOTE: To achieve optimum PID performance, the actual input range span is narrower than listed: T/C °F input = 600°; T/C °C = 500°; RTD °F = 600°; RTD °C = 500°. (Linear input span is set by the user.) Hysteresis functions, Proportional Band, and Set Point limits are determined by this span. If this configured input range span is too narrow for one or more of these desired parameter settings, contact Simpson Technical Support for adjustment instructions.

Operation cont.

DISPLAY FUNCTION

In normal display mode, the upper display indicates the measured value, while the lower display shows the set point value.

The lower display can be used to show other information as follows:

- 1) Press the FUNC button and hold for three seconds. If Heater Break Detection (HBD) has been selected, the lower display will show "A." followed by the OUTPUT 1 current level as measured by the HBD current transformer.
- 2) Press FUNC again. The lower display will now show "H." followed by the OUTPUT 1 power value, expressed from 0 to 100 %. This represents the time OUTPUT 1 is ON vs. the Cycle Time.
- 3) If OUTPUT 2 has been selected as a Cooling Output, press FUNC again. The lower display will show "C." followed by the OUTPUT 2 power value.
- 4) Press FUNC again to return to normal display mode.

NOTE: Failure to press a button within 30 seconds will cause the display to return to normal display mode. To keep one of the above values on the lower display, press ▲ or ▼ to cancel the timer function. When ready to return to normal display mode, simply press FUNC again.

DIRECT ACCESS TO SET POINT

It is possible to change the set point without going through the entire Operating Parameter selection.

Make sure the Phoenix is in Auto Mode and normal display mode (no parameters are being modified). Press ▲ or ▼ and hold for two seconds. The set point value in the lower display will begin changing.

Press ▲ or ▼ until the desired set point value is reached. This new set point value will take effect after a two-second delay with no buttons being pressed.

MANUAL MODE

The output power levels can be manually adjusted in Manual Mode. When the Phoenix is operating in normal display mode, the Manual Mode function can be accessed by pressing MAN for more than one second. The decimal point in the middle of the lower display will flash to indicate that the instrument is in Manual Mode.

The OUTPUT 1 power output value is shown (in %) in the two most significant digits of the lower display. The OUTPUT 2 % value, if any, appears in the two least

significant digits. These output values can be modified by pressing ▲ or ▼.

To return to Auto Mode, press MAN again for more than one second. The transfer between Auto and Manual Mode is bumpless.

NOTE: If the instrument is turned off while in Manual Mode, it will revert to Auto Mode PID control when powered up again.

OUTPUT POWER OFF FUNCTION

The Phoenix P140 can be operated as an indicator by turning off the control output power. To disable the output power, make sure the instrument is in normal display mode, then press ▲ and FUNC simultaneously for 5 seconds.

The P140 will now function as an indicator. "OFF" will appear in the lower display. Alarms, if any, will be in non-alarm condition.

To restore the control output power, press ▲ and FUNC simultaneously for 5 seconds.

ERROR MESSAGES

The Phoenix PID controller performs self-diagnostic testing and indicates on the display any errors detected.

Overrange: 0000

Underrange: _000

Sensor Lead Break:

T/C, RTD, mV: Overage

mA, V: Underrange

Coded Messages

When other errors are detected, "Err" appears in the lower display and the corresponding error code (e.g. "100," "200") shows in the upper display.

NOTE: Contact Simpson Technical Support at (708) 697-2260 for instructions on how to correct the error condition or to return the instrument for repair.

CONFIGURATION

The configuration parameters of this instrument have been programmed according to the part number ordered. If the original application changes, the instrument can be reconfigured by Simpson or by an authorized Phoenix modification center. Call Technical Support at (708) 697-2260 for more details.

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

Options

HEATER BREAK DETECTION

An optional alarm is available on the Phoenix to monitor the OUTPUT 1 (Heating) load current. The Heater Break Detection (HBD) function measures the current flowing through the power line of the equipment being controlled by OUTPUT 1. If the current level drops below the pre-determined HBD threshold value, the alarm is triggered and the OUT 3 LED indicator will flash.

The sampling of the load current will occur only if the power output has been applied to the load for at least 50ms.

NOTE: A current transformer with 50 mA AC secondary is required for the Heater Break Detection option. For ordering information, see the Accessories section on the last page.

AUXILIARY SET POINT

An optional logic input provides a second set point on the Phoenix. This auxiliary set point is useful in applications that call for a different temperature to be maintained during non-working hours, or for processes where the material may be changed, eliminating the need for a separate controller.

Transfer from the main set point (SP) to the auxiliary set point (SP2) and vice-versa is driven by logic input (contact closure). The transfer may be done via ramp or via step transfer.

NOTE: The operating set point (SP or SP2) must be selected by external contact, at terminals #14 and #15. For this reason, the Auxiliary Set Point option may not be used in conjunction with Heater Break Detection.

Application Example

An instrument engineer at a plastics molding company needs a temperature controller to maintain the temperature in the blow molder at 425°F. Overshoot is a concern, because the plastic may burn if the temperature exceeds 435°F, so an alarm needs to be activated at 435°F and remain on until manually reset. Another alarm needs to be activated if the temperature drops below 375°F.

A Phoenix P140-0-L-0-1-3-1-4-0-1 will satisfy these requirements: Type J T/C input with a range of 0 to 1830°F, relay with reverse action for heating on Output 1, process alarm 1 for Output 2, high alarm with manual reset for the alarm operating mode, process alarm 2 as low alarm with manual reset, and safety lock to prohibit access to parameters without entering a password.

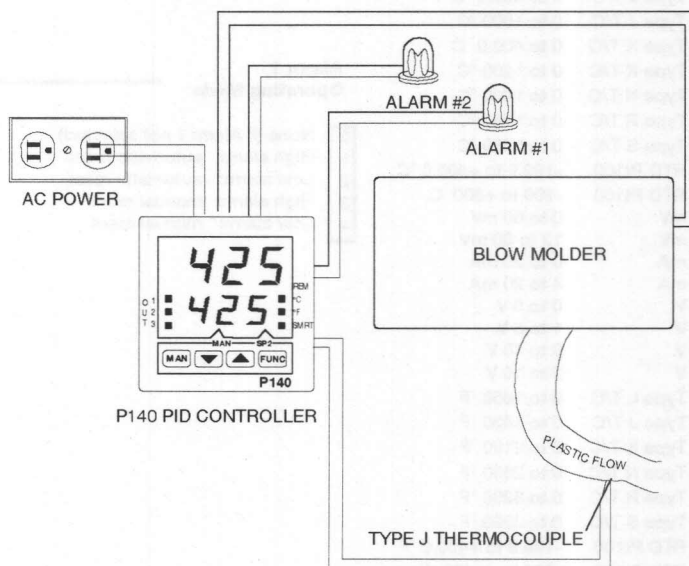
The P140's Soft Start function will reduce the risk of overshoot by regulating the approach to the set point temperature. The heating output will only be on for a percentage of each output on and off cycle, causing the temperature to rise at a slower pace.

The Phoenix is connected according to the wiring diagram, then FUNC is pressed to enter the Operating Parameter selection mode.

"SP" is set at 425 (°F), the desired set point temperature. "Snrt" is changed to On, to enable SMART Tuning.

"n.Rst" should display OFF, as the alarm has not been reset, and "nnn" should display OFF, indicating that Safety Lock is inactive, to set the remaining parameters.

"AL1" is the next parameter to appear and is set at 435 (°F), the temperature at which the alarm is to be activated. "HSA1" can be left at 0.1%; the temperature must then drop below 435°F by 0.1% of the configured input range span before the alarm is deactivated, eliminating "chatter" in the alarm relay should the measured value bounce around the alarm threshold. "AL2," the low alarm, is set at 375 (°F) and "HSA2" at 0.1%. Pre-con-



figured alarm masking prohibits the alarms from being tripped during start-up until the temperature has reached the set point.

"Pb," "ti," and "td" can be left at the values displayed, as SMART Tuning will automatically adjust these parameters.

"CY1" is set at 15, indicating that one output on and off cycle for the main output lasts for 15 seconds. The next parameter to adjust is "OLH", which is set at 50. The main output will then be on for 50% of each 15-second cycle during Soft Start, allowing the plastic to warm up gradually to 425°F.

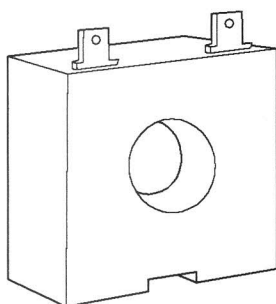
At this point, press FUNC again until "nnn" appears in the lower display. Change "nnn" to On to activate Safety Lock.

After waiting for 30 seconds, the P140 will exit Operating Parameter selection mode and SMART Tuning begins.

Ordering Information

Model P140 4 Digit		Output 1 (Main Output) 0 Relay: reverse action (Heating) 1 Relay: direct action (Cooling) 2 SSR: reverse action (Heating) 3 SSR: direct action (Cooling)		Alarm 2 Operating Mode 0 None (if Alarm 2 not selected) 1 High alarm: automatic reset 2 Low alarm: automatic reset 3 High alarm: manual reset 4 Low alarm: manual reset	
Power Supply 0 100-240 VAC		Output 2 (Relay) 0 Not used 1 Alarm 1: process alarm 2 Alarm 1: band alarm 3 Alarm 1: deviation alarm 4 Cooling output: air * 5 Cooling output: oil * 6 Cooling output: H2O * * requires Output 1 to be heating output		Primary Current for Transformer 0 None (if Heater Break Detection not selected) 1 10 Amp AC 2 25 Amp AC 3 50 Amp AC 4 100 Amp AC NOTE: Current Transformers sold separately.	
Input 0 Type L T/C 0 to 400.0 °C 1 Type L T/C 0 to 900 °C 2 Type J T/C 0 to 400.0 °C 3 Type J T/C 0 to 1000 °C 4 Type K T/C 0 to 400.0 °C 5 Type K T/C 0 to 1200 °C 6 Type N T/C 0 to 1400 °C 7 Type R T/C 0 to 1760 °C 8 Type S T/C 0 to 1760 °C 9 RTD Pt100 -199.9 to +400.0 °C A RTD Pt100 -200 to +800 °C B mV 0 to 60 mV C mV 12 to 60 mV D mA 0 to 20 mA E mA 4 to 20 mA F V 0 to 5 V G V 1 to 5 V H V 0 to 10 V J V 2 to 10 V K Type L T/C 0 to 1650 °F L Type J T/C 0 to 1830 °F M Type K T/C 0 to 2190 °F N Type N T/C 0 to 2550 °F P Type R T/C 0 to 3200 °F Q Type S T/C 0 to 3200 °F R RTD Pt100 -199.9 to +400.0 °F S RTD Pt100 -330 to +1470 °F		Alarm 1 Operating Mode 0 None (if Alarm 1 not selected) 1 High alarm: automatic reset 2 Low alarm: automatic reset 3 High alarm: manual reset 4 Low alarm: manual reset		Safety Lock (Parameter Protection) 0 No parameter protection 1 Password protection	
Options 0 None 1 Alarm 2: process alarm 2 Alarm 2: band alarm 3 Alarm 2: deviation alarm 4 Heater Break Detection + Alarm 2: process alarm 5 Heater Break Detection + Alarm 2: band alarm 6 Heater Break Detection + Alarm 2: deviation alarm 7 Auxiliary Set Point + Alarm 2: process alarm 8 Auxiliary Set Point + Alarm 2: band alarm 9 Auxiliary Set Point + Alarm 2: deviation alarm					

Accessories

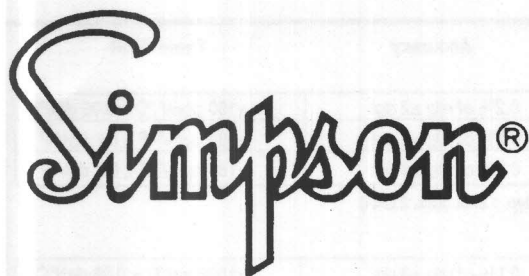


The PCTR series Current Transformer should be ordered for Phoenix PID controllers with the Heater Break Detection option. This Current Transformer measures the Output 1 current and sends a signal to the Phoenix if that load current drops below the pre-programmed threshold. Spade terminals permit easy connection. Leads are not included.

Catalog Number	Primary (ACA)	Secondary (ACmA)	Accuracy@ 0.2VA Pmax
PCTR10	10	50	2.3 %
PCTR25	25	50	2.0 %
PCTR50	50	50	1.0 %
PCTR100	100	50	1.0 %

Nominal Operating Frequency: 50 to 60Hz

NOTE: Thermocouples and Temperature Transmitters compatible with the Phoenix PID controllers are also available from Simpson. Contact factory for more information.



Temperature Controllers

HAWK II Hawk II H235 Series 3-1/2 Digit On-Off Controllers

- **Easily Programmed from the Front Panel**
- **User Friendly Software Functions Include:**
 Password
 Display either °F or °C
 Decimal Point Selection
 Zero, One, or Two Setpoints
 Peak-Valley Values
 Time Delay & Hysteresis
- **Screw Terminal Connector for Easy Installation**
- **1/8 DIN, Shallow Depth Case, 3.5" (89mm) for Restricted Space Behind Panel**
- **Nema 4 / IP 65 Front Panel**
- **3 Temperature Options: J T/C, K T/C, RTD Pt 100 Ω**
- **Optional 5 Amp Relay Outputs, Excitation Outputs, and Analog Outputs**



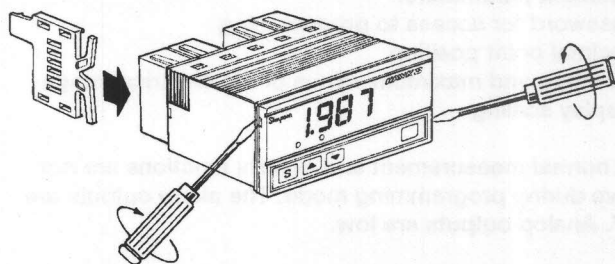
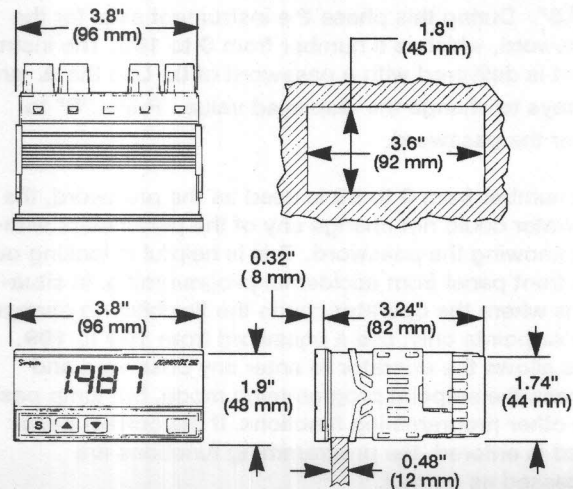
Simpson's Hawk II Microprocessor based Indicator/Controllers are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering units. Excitation outputs are available for external transmitters and transducers.

Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog outputs are also available. Other programmable software features include programmable decimal point and a password lockout feature.

Depending on the password value chosen, the customer may lock out all changes or merely those relating to setup, leaving the setpoint values accessible to the operator.

The Hawk II Series Indicator/ Controllers are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case with a depth of only 3.56" (90mm). The Hawk II has a Nema 4 / IP 65 rated front panel which equips the unit for wash down environments. Screw terminals are standard for easy installation.

Installation and Panel Cutout



Insert the instrument into the panel and fasten it with the two brackets provided.

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED

Height: 0.56" (14.2mm)

Decimal Point: 3 position software programmable from front panel

Overrange: Display reads "EE"

Underrange: Display reads "-EE"

Alarm Indicators: Two LED indicators for alarm conditions on front panel

POWER REQUIREMENTS

AC Voltages: 24, 48, 115, 230 VAC, $\pm 10\%$

DC Voltages: Future Availability

Power Consumption: 6 VA

ENVIRONMENTAL

Operating Temperature: 0°C to +50°C

Storage Temperature: -10°C to +60°C

Relative Humidity: <90% non-condensing

Ambient Temperature: 23°C

Warmup Time: 10 minutes

NOISE REJECTION

NMRR: 50 dB, GR = 50 Ω

CMRR: 100 dB, GR = 1 K Ω

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate: Approximately 2 display updates per second, nominal

MECHANICAL

Bezel: 3.8" x 1.9" x .32" (96mm x 48mm x 8.1mm)

Depth: 3.56" (90mm)

Panel Cutout: 3.6" x 1.8" (92mm x 45mm) 1/8 DIN

Case Material: ABS/Polycarbonate blend

Weight: 10.5 oz. (297.7 g)

Range	Resolution	Accuracy	Temp. Drift
RTD Pt100 Input			
-100.0 to +199.9 °C	0.1 °C	0.2% of rdg ± 2 dgt	± 150 ppm/°C ± 0.05 dgt/°C
-148.0 to +199.9 °F	0.2 °F	0.2% of rdg ± 4 dgt	± 180 ppm/°F ± 0.1 dgt/°F
-148 to +392 °F	1 °F	0.2% of rdg ± 4 dgt	± 180 ppm/°F ± 0.1 dgt/°F

Open circuit voltage: max. 6VDC Excitation current: typ. 1.8mA (max. 2.0mA)

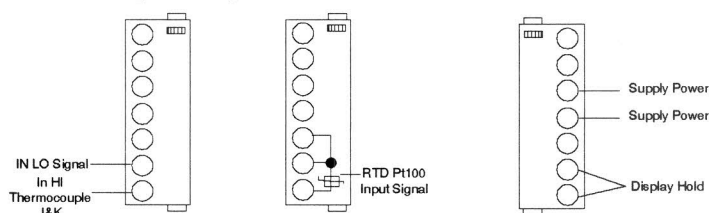
Type J Thermocouple Input

-100 to +760 °C	1 °C	0.1% of rdg ± 3 dgt	± 100 ppm/°C ± 0.05 dgt/°C
-100 to +499 °C	1 °C	0.1% of rdg ± 3 dgt	± 100 ppm/°C ± 0.05 dgt/°C
500 to 760 °C	1 °C	0.1% of rdg ± 4 dgt	± 100 ppm/°C ± 0.05 dgt/°C
-148 to +1400 °F	1 °F	0.1% of rdg ± 3 dgt	± 180 ppm/°F ± 0.1 dgt/°F
-148 to +399 °F	1 °F	0.1% of rdg ± 3 dgt	± 180 ppm/°F ± 0.1 dgt/°F
400 to 1400 °F	1 °F	0.5% of rdg ± 3 dgt	± 180 ppm/°F ± 0.1 dgt/°F

Type K Thermocouple Input

-100 to +1250 °C	1 °C	1% of rdg $\pm 5/-1$ dgt	± 100 ppm/°C ± 0.05 dgt/°C
-100 to -50 °C	1 °C	1% of rdg $\pm 5/-1$ dgt	± 100 ppm/°C ± 0.05 dgt/°C
-49 to +780 °C	1 °C	0.1% of rdg ± 3 dgt	± 100 ppm/°C ± 0.05 dgt/°C
781 to 1250 °C	1 °C	0.3% of rdg $\pm 1/-3$ dgt	± 100 ppm/°C ± 0.05 dgt/°C
-148 to +1999 °F	2 °F	1% of rdg $\pm 10/-2$ dgt	± 180 ppm/°F ± 0.1 dgt/°F
-148 to -58 °F	2 °F	1% of rdg $\pm 10/-2$ dgt	± 180 ppm/°F ± 0.1 dgt/°F
-59 to +399 °F	2 °F	0.2% of rdg ± 3 dgt	± 180 ppm/°F ± 0.1 dgt/°F
400 to 1999 °F	2 °F	0.6% of rdg ± 3 dgt	± 180 ppm/°F ± 0.1 dgt/°F

Wiring Diagram



Input Signal: Connect the signal to be monitored to the IN HI and the IN LO terminals. Note that there are different connections depending on the type of input sensor.

Supply Power: Connect the power to the supply power terminals.
Display Hold: Short the terminals marked HOLD to activate. The comparison of the input variable with the alarm setpoint remains active. To re-activate this display, disconnect the short circuit.

Programming

The Programming mode allows the user to define the instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling

The normal measurement and control functions are not active during programming mode. The alarm outputs are OFF. Analog outputs are low.

Termination of programming mode and return to the measurement and control mode is automatic at the end of all the programming steps or after 3 minutes with no key activation. Display will briefly show "End".

Access to programming

Press the "S" key and the $\blacktriangle$. The display should show "PAS". During this phase the instrument asks for the password, which is a number from 0 to 199. The instrument is delivered with a password of 0. Use the $\blacktriangle$ and $\blacktriangledown$ keys to change the displayed value. Press "S" to enter the password.

If a number from 0 to 99 is used as the password, the operator could not change any of the parameters without knowing the password. This is helpful in locking out the front panel from accidental programming. In situations where the operator needs the flexibility to change the setpoints only, use a password from 100 to 199. This allows the operator to enter any password and access the setpoint programming mode, but jump past the other programming functions. If the correct password is entered, the programming functions are accessed as normal.

Programming cont.

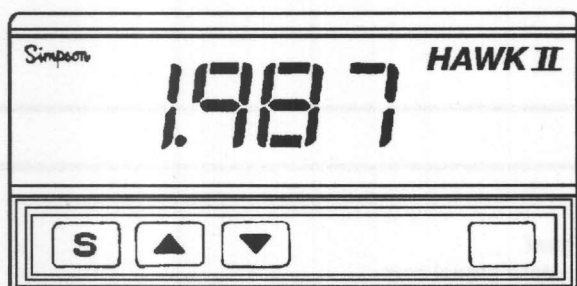
Forgot your password?

If the password is forgotten, it can be reset to 0. The unit must be powered down. Hold down the "S" key and the ▼ key at the same time, and power up the unit. Release the keys when the display shows **PAS** for about two seconds. Press the ▲ key so the display reads **99**. Press the "S" key to enter this value, and the reset is done automatically. The mode is terminated, and the system is restarted.

Programming a new password

To retain the present value for the password, press the "S" key to pass to the next parameter.

To modify the password, press the ▲ and ▼ keys to affect the value. Remember that the value must be a number from 0 to 199. Press "S" to move to the next parameter.



Decimal Point and Range Selection

The Hawk II controller allows you to select either °F or °C for the temperature indication. The decimal point position, electrical input range, and Hi and LO display values depend on the type of input ordered and are all set at the factory. There is no need to change these values if you prefer the default °F indication.

The temperature indication can be easily changed from the default setting by programming the appropriate values from the following table. Use the ▲ and ▼ keys to change the displayed value. Press the "S" key to enter the new value and move to the next parameter.

(The factory default setting for each input type is shown in bold. To retain these values, simply press the "S" key after each of the parameters, dP through LO, appears.)

For Type J Thermocouple Input

°C	°F
dP: 1111	dP: 1111
HiE: 1999	HiE: 1999
LOE: -264	LOE: -264
Hi: 760	Hi: 1400
LO: -100	LO: -148

For Type K Thermocouple Input

°C	°F
dP: 1111	dP: 1111
HiE: 1999	HiE: 1748
LOE: -160	LOE: -160
Hi: 1250	Hi: 1999
LO: -100	LO: -148

For RTD Pt100 Input

Range: -100.0 to 199.9 °C

dP: 111.1
HiE: 199.9
LOE: -100.0
Hi: 199.9
LO: -100.0

Range: 148.0 to 199.9 °F

dP: 111.1
HiE: 93.2
LOE: -100.0
Hi: 199.9
LO: -148.0

Range: -148 to 392 °F

dP: 1111
HiE: 199.9
LOE: -100.0
Hi: 393
LO: -148

Explanation of above terms

dP = decimal point

HiE = maximum electrical input range

LOE = minimum electrical input range

Hi = displayed value corresponding to the maximum of input range (HiE)

LO = displayed value corresponding to the minimum of input range (LOE)

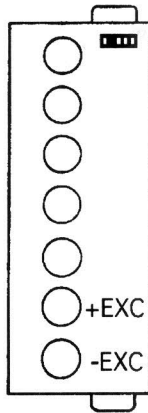
The programming sequence will end here and revert to normal operation unless there are relays built into the unit. If so, the meter will display SP1. This information is in the Programming the Relays section.

Excitation Output

Optional 12 or 24 VDC Excitation power supply is available on the Hawk II. This Excitation power can be used to energize many common types of transducers and transmitters. By using the Excitation power from the Hawk II you do not have to set up an external power source for transmitters or transducers.

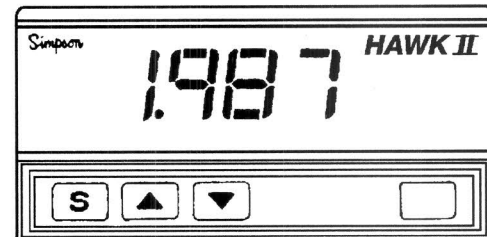
The source is isolated from the measurement input as well as the input power circuits. The connections are made to the +EXC and the -EXC terminals on the rear of the meter. Maximum current load is 20 mA for either 12 or 24 VDC.

Note: Excitation power is not available in conjunction with analog output.



Peak-Valley

By pressing both the ▲ and the ▼ keys at the same time, the highest and lowest values are displayed. These are referred to as the Peak and Valley values. The Hawk II displays the Peak first, then the Valley, then returns to the normal operation. To reset the values in memory, press all three buttons at the same time.



Analog Output

All Analog output signals are linearly proportional to the displayed values.

CAUTION

Isolation voltage of 125 Vrms between analog output and the rest of the Hawk II system limits the use of the system, and is only intended to break ground loops, not as a safety isolation.

4-20 DC mA Output signal:

Relationship between the output signal and displayed value: $I = \frac{16}{Hi-Lo} (RDG-Lo)+4$

I = Output current (mA)

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

0-20 DC mA Output signal

Relationship between output signal and displayed value: $I = 20(RDG-Lo) / Hi - Lo$

I = Output current (mA)

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

0-10 VDC Output signal

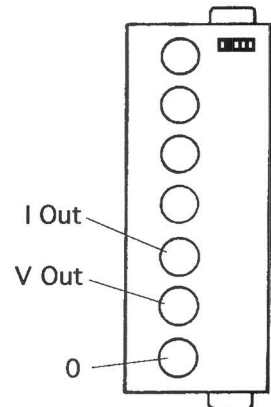
Relationship between output signal and displayed value: $V = 10(RDG-Lo) / Hi - Lo$

V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value



Relationship between over/underrange situations and Analog outputs:

Input signal to Hawk II	Display Indication	Output 4-20mA	Output 0-20mA	Output 0-10 V
Overrange	EE	20 mA	20 mA	10 V
Underrange	- EE	4 mA	0 mA	0 V

NOTE:

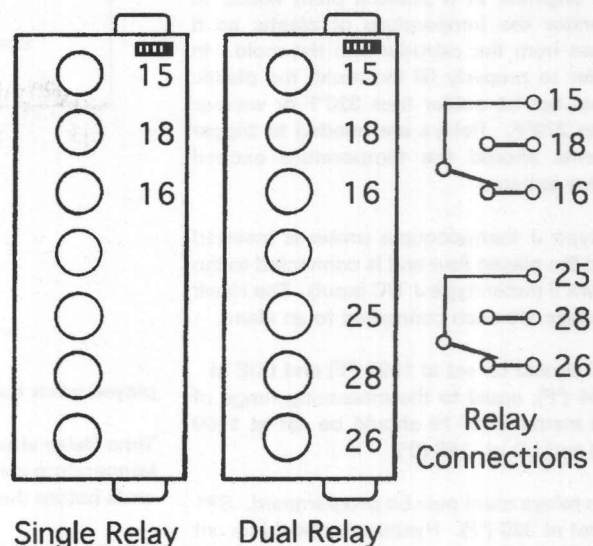
Analog output is not available in conjunction with Excitation.

Output Range	Accuracy	Temperature Drift	Max. Load Resistance	Output Resistance	Short-Circuit Protection
4-20 mA	±1% ±0.1 mA	±200 ppm/ °C	500 Ohm	N/A	Yes
0-20 mA	±1% ±0.1 mA	±200 ppm/ °C	500 Ohm	N/A	Yes
0-10 V	±1% ±0.05V	±200 ppm/ °C	N/A	≤3 Ohm	Yes

Relays

Optional relays are available with the Hawk II. The relays are 5 amp, 250 VAC, SPDT models. Up to 2 relays can be installed in the Hawk II controller. The relays are programmed through the software in the Hawk II to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the setpoints. Hysteresis is easily programmed in the Hawk II to eliminate "chatter" in the relays. The Hawk II has a Time Delay adjustment of 0 to 99 seconds for the setpoints.

Relays can be used to "turn on" or "turn off" power to a process that the Hawk II is monitoring. A light can be "turned on" when a setpoint is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk II can be controlled with the relays by wiring them together, "turning on" or "turning off" the excitation when a setpoint is reached or exceeded.



Programming the Relays

The Hawk II automatically senses if a relay card is present in the instrument. Programming continues after you have set the **Hi** parameter. When relays are present you must program the following values (in this order):

- Setpoint Values
- Hysteresis
- Time Delay
- High or Low Alarm Levels
- Relay Status
- Overrange Status

The programming for Setpoint Value (**SP1**), Hysteresis (**HYS**), Time Delay (**dEL**), High (**uP**) or Low (**do**) Alarm Levels, Relay Status (**nE** and **nd**) and Overrange Status (**On/OFF**) are performed in the same manner:

1. The display will show **SP1** (or other programming variable), and then display the stored setpoint value.
2. To retain the present value, press the "**S**" key to pass to the next parameter.
3. To select a new value, press the **▲** or **▼** to increase or decrease the displayed value.
4. Press "**S**" when you have reached your desired value to pass to the next parameter.

Setpoint Values: The setpoint is relative to the display span and not to the electrical input range. Please remember that you can program a password to enable only the setpoints to be changed. This allows the operator flexibility in using the Hawk II, without the potential for erroneous programming of other parameters. If an incorrect password is entered, the program jumps to the **SP1** mode. If the correct password is entered (100-199), the operator can change the parameters.

Hysteresis: Hysteresis is the difference between the programmed setpoint value (value at which the alarm is set ON) and the value at which the alarm is disabled. If a reading is flipping between two points that are above and below the setpoint, this can cause the relay to "chatter" on and off rapidly. Hysteresis helps eliminate this "chatter" in the relays. The hysteresis value is selected from 1 to 1999 counts.

Time Delay: The Time Delay is programmable from 0 to 99 seconds. Time Delay is similar to Hysteresis, but instead allows the input to exceed the setpoint for a specific amount of time before triggering the relay. For example, 2 would delay the relay from energizing for 2 seconds after exceeding the setpoint. The Time Delay is reset when the input falls below the setpoint.

High and Low Alarm Levels: You must choose if the relay is to be triggered when the input exceeds (for High Alarm = **uP**) or falls below (Low Alarm = **do**) the setpoint.

Relay Status: This parameter determines the state of the relay in the absence of an alarm: Normally Energized or Normally De-Energized.

Overrange Status: This allows the user to choose if the relay is on or off in an overflow/underflow condition.

At this point, if a second relay is also installed in the unit, **SP2** will be displayed and this procedure repeated for the second relay. After all parameters have been programmed, the programming mode is terminated automatically, and the system restarts. In normal operation, the setpoints can be displayed by pressing the **▲** key to show **SP1**, or the **▼** key to show **SP2**.

Application Example

An engineer at a plastics plant needs to monitor the temperature of plastic as it flows from the extruder into the mold. In order to properly fill the mold, the plastic must not be colder than 320°F or warmer than 370°F. Relays are needed to trigger alarms should the temperature exceed either extreme.

A type J thermocouple probe is inserted into the plastic flow and is connected to the Hawk II meter (type J T/C input). The Hawk II relays are each connected to an alarm.

HiE should be set at 1999 (°F) and LOE at -264 (°F), equal to the measuring range of the instrument. Hi should be set at 1400 (°F) and LO at -148 (°F).

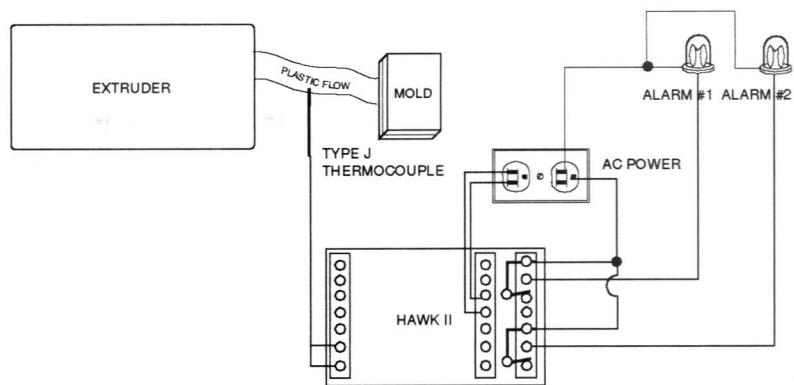
The relays must now be programmed. SP1 is set at 320 (°F). Hysteresis should be set at 3.0. This will allow the displayed value to deviate from the setpoint by 3 counts, eliminating "chatter" in the relay should the displayed value bounce around the setpoint.

Time Delay should be set at 5, so that the temperature can fall below 320°F for 5 seconds before the relay is energized.

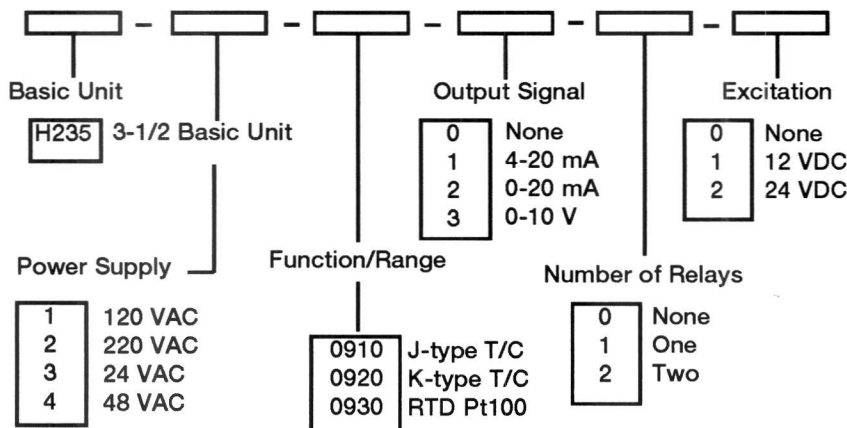
Set the Alarm Level for down ("do"), so that the relay is energized when the temperature drops below the setpoint.

Relay Status is normally de-energized (nd), representing the relay status in the absence of an alarm situation.

SP2 is set at 370 (°F). Hysteresis should be 3.0 and Time Delay 5. Set the Alarm Level for up ("uP"), so that the relay is energized when the temperature rises above 370°F. Relay Status is normally de-energized (nd).



Ordering Information



Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

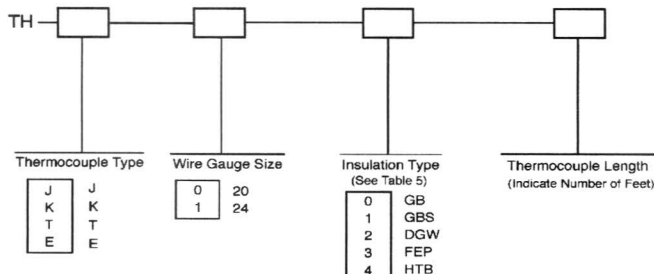
CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

Accessories

Simpson thermocouples are available in custom lengths per your application. Calibration type, wire gauge, insulation type, and length are determined by your specs, and entered into the following ordering diagram.

Thermocouple Ordering Information (Termination End: HJ-Beaded, CJ-Solid Bare Wire)



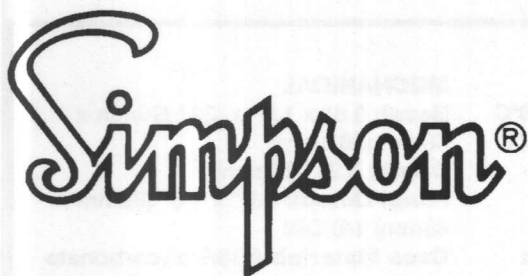
THERMOCOUPLE PROBES (QUICK DISCONNECT)

Simpson offers "Quick Disconnect" style thermocouples which include a probe and an ANSI color coded jack and plug. Each 12 inch thermocouple probe is compacted with MgO insulation, with 316 stainless steel and 0.188 inch diameter outer sheath. Extra plugs and jacks are sold separately. See the table below for ordering information.

THERMOCOUPLE PROBES (48 INCH LEAD WIRE)

Simpson's transition joint thermocouple probes are constructed with MgO insulation. The probe includes 48" of Teflon® coated thermocouple wire and stripped leads.

Type	Catalog Numbers				
	ANSI Color Code	Quick Disconnect	48 Inch Lead Wire	Plug Only	Jack Only
J	Black	21238	21242	21245	21249
K	Yellow	21239	21243	21246	21250
T	Blue	21240	-----	21247	21251
E	Purple	21241	-----	21248	21252
RTD	-----	-----	21244	-----	-----



Resistance Controllers

HAWK II Hawk II H235 Series 3-1/2 Digit On-Off Controllers

- **Easily Programmed from the Front Panel**
- **User Friendly Software Functions Include:**
 Password
 Display Scaling and Offset
 Decimal Point Selection
 Zero, One, or Two Setpoints
 Peak-Valley Values
 Time Delay & Hysteresis
- **Screw Terminal Connector for Easy Installation**
- **1/8 DIN, Shallow Depth Case,
 3.24" (82mm) for Restricted Space Behind Panel**
- **Nema 4 / IP 65 Front Panel**
- **4 Resistance Ranges: 200 Ω , 2 K Ω , 20 K Ω , 200 K Ω**
- **Optional 5 Amp Relay Outputs,
 Excitation Outputs, and Analog Outputs**



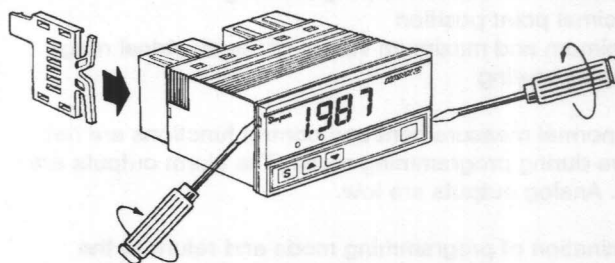
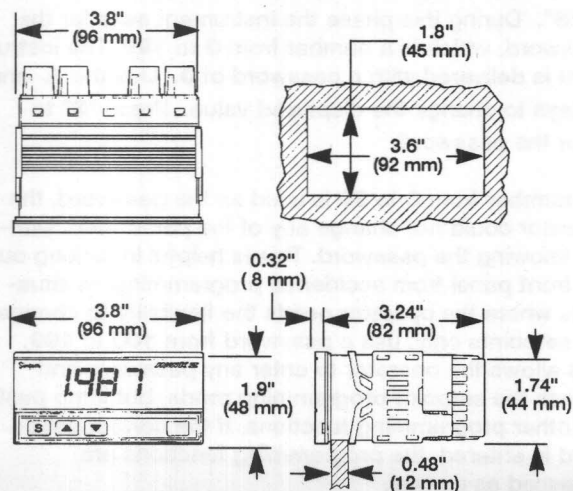
Simpson's Hawk II Microprocessor based Indicator/Controllers are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering units. Excitation outputs are available for external transmitters and transducers.

Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog outputs are also available. Other programmable software features include programmable decimal point and a password lockout feature.

Depending on the password value chosen, the customer may lock out all changes or merely those relating to setup, leaving the setpoint values accessible to the operator.

The Hawk II Series Indicator/ Controllers are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case with a depth behind the panel of only 3.24" (82mm). The Hawk II has a Nema 4 / IP 65 rated front panel which equips the unit for wash down environments. Screw terminals are standard for easy installation.

Installation and Panel Cutout



Insert the instrument into the panel and fasten it with the two brackets provided.

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED

Height: 0.56" (14.2mm)

Decimal Point: 3 position software programmable from front panel

Overrange: Display reads "EE"

Underrange: Display reads "-EE"

Alarm Indicators: Two LED indicators for alarm conditions on front panel

POWER REQUIREMENTS

AC Voltages: 24, 48, 115, 230 VAC, $\pm 10\%$

DC Voltages: Future Availability

Power Consumption: 6 VA

ACCURACY:

0.2% $\pm$ 2 digits

ENVIRONMENTAL

Operating Temperature: 0°C to +50°C

Storage Temperature: -10°C to +60°C

Relative Humidity: <90% non-condensing

Ambient Temperature: 23°C

Temperature Coefficient (per °C):

± 150 ppm/°C

± 0.05 dgt/°C

Warmup Time: 10 minutes

NOISE REJECTION

NMRR: 50 dB, GR = 50 Ω

CMRR: 100 dB, GR = 1 K Ω

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate: Approximately 2 display updates per second, nominal

MECHANICAL

Bezel: 3.8" x 1.9" x .32" (96mm x 48mm x 8.1mm)

Depth: 3.24" (82mm)

Panel Cutout: 3.6" x 1.8" (92mm x 45mm) 1/8 DIN

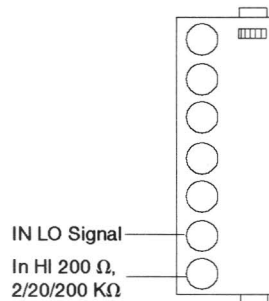
Case Material: ABS/Polycarbonate blend

Weight: 10.5 oz. (297.7 g)

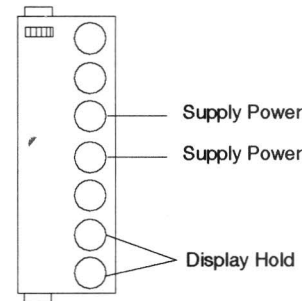
Inputs: Resistance

Input Range	Display Resolution	Open Circuit Voltage	Max. Excitation Current
199.9 Ω	0.1 Ω	6 VDC Max.	1 mA
1.999 K Ω	1 Ω		100 μ A
19.99 K Ω	10 Ω		10 μ A
199.9 K Ω	100 Ω		1 μ A

Wiring Diagram



Input Signal: Connect the signal to be monitored to the IN HI and the IN LO terminals. Note that there is only one IN HI terminal on the Hawk II Resistance controller, regardless of the input range selected.



Supply Power: Connect the power to the supply power terminals. **Display Hold:** Short the terminals marked HOLD to activate. The comparison of the input variable with the alarm setpoint remains active. To re-activate this display, disconnect the short circuit.

Programming

The Programming mode allows the user to define the instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling

The normal measurement and control functions are not active during programming mode. The alarm outputs are OFF. Analog outputs are low.

Termination of programming mode and return to the measurement and control mode is automatic at the end of all the programming steps or after 3 minutes with no key activation. Display will briefly show "End".

Access to programming

Press the "S" key and the $\blacktriangle$. The display should show "PAS". During this phase the instrument asks for the password, which is a number from 0 to 199. The instrument is delivered with a password of 0. Use the $\blacktriangle$ and $\blacktriangledown$ keys to change the displayed value. Press "S" to enter the password.

If a number from 0 to 99 is used as the password, the operator could not change any of the parameters without knowing the password. This is helpful in locking out the front panel from accidental programming. In situations where the operator needs the flexibility to change the setpoints only, use a password from 100 to 199. This allows the operator to enter any password and access the setpoint programming mode, but jump past the other programming functions. If the correct password is entered, the programming functions are accessed as normal.

Programming cont.

Forgot your password?

If the password is forgotten, it can be reset to 0. The unit must be powered down. Hold down the "S" key and the ▼ key at the same time, and power up the unit. Release the keys when the display shows **PAS** for about two seconds. Press the ▲ key so the display reads **99**. Press the "S" key to enter this value, and the reset is done automatically. The mode is terminated, and the system is restarted.

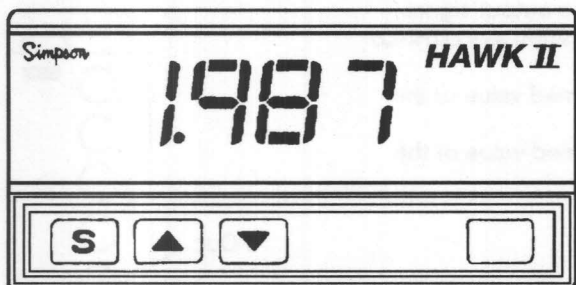
Programming a new password

To retain the present value for the password, press the "S" key to pass to the next parameter.

To modify the password, press the ▲ and ▼ keys to affect the value. Remember that the value must be a number from 0 to 199. Press "S" to move to the next parameter.

Decimal Point Selection

The display will show "dP" for about 2 seconds. The display will then show the current position of the decimal point on the display by a steady light (see the following figure). Change the position with the ▲ and ▼ keys. Press "S" to move to the next parameter.



Programming the electrical input range (HiE and LOE)

This feature allows you to define the electrical input range. It also allows you to define a range different from the standard one.

The display will show **HiE**, signifying the maximum electrical input range. The value stored in memory is displayed. To retain the present value, press the "S" key. Use the ▲ and ▼ keys to change the displayed value. Press the "S" key when the correct value is displayed.

The Display will show **LOE** for about 2 seconds, signifying the minimum electrical input range. The display will then show the value stored in memory. Use the ▲ and ▼ keys to change the displayed value. Press the "S" key when the correct value is displayed.

The **HiE** and **LOE** values are shown in the same engineering units as the input range.

Display Scaling

This allows you to define the display span (in engineering units) corresponding to the previously defined electrical input range. For example:

Programmed elec. input range: 0 to +19.99 (LOE to HiE)

Programmed display span: 0 to 100% (LO to Hi)

LO = displayed value corresponding to the minimum of input range (**LOE**).

Hi = displayed value corresponding to the maximum of input range (**HiE**).

The link between the electrical and the displayed value is completely adjustable/variable, thus it is possible to correlate a minimum electrical value to a maximum display value, and vice versa (scale inversion).

For best resolution, see formula at bottom of page.

The display will show "**Hi**" for about 2 seconds. Then the display will indicate the **Hi** value stored in memory.

Use the ▲ and ▼ keys to change the displayed value. The maximum is **+1999**. Press the "S" key when the correct value is displayed.

The display will show "**LO**" signifying the minimum of the display span. The display shows the value stored in memory. To modify the value, use the ▲ and ▼ keys. The value can be as low as **-1999** in the Resistance meter. Press the "S" key to pass to the next parameter.

The programming sequence will end here and revert to normal operation unless there are relays built into the unit. If so, the meter will display SP1. This information is in the Programming the Relays section.

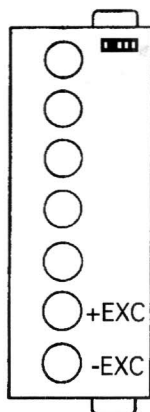
$$\left| \frac{\text{HiE} - \text{LoE}}{\text{Hi} - \text{Lo}} \right| \geq 1$$

Excitation Output

Optional 12 or 24 VDC Excitation power supply is available on the Hawk II. This Excitation power can be used to energize many common types of transducers and transmitters. By using the Excitation power from the Hawk II you do not have to set up an external power source for transmitters or transducers.

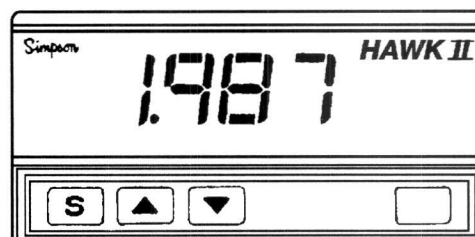
The source is isolated from the measurement input as well as the input power circuits. The connections are made to the +EXC and the -EXC terminals on the rear of the meter. Maximum Current load is 20 mA for either 12 or 24 VDC.

Note: Excitation power is not available in conjunction with analog output.



Peak-Valley

By pressing both the ▲ and the ▼ keys at the same time, the highest and lowest values are displayed. These are referred to as the Peak and Valley values. The Hawk II displays the Peak first, then the Valley, then returns to the normal operation. To reset the values in memory, press all three buttons at the same time.



Analog Output

All Analog output signals are linearly proportional to the displayed values.

CAUTION

Isolation voltage of 125 Vrms between analog output and the rest of the Hawk II system limits the use of the system, and is only intended to break ground loops, not as a safety isolation.

4-20 DC mA Output signal:

Relationship between the output signal and displayed value: $I = \frac{16}{Hi-Lo} (RDG-Lo)+4$

I = Output current (mA)

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

0-20 DC mA Output signal:

Relationship between the output signal and displayed value: $I = 20(RDG-Lo)/Hi-Lo$

I = Output current (mA)

Hi = Maximum programmed value of the whole measuring range.

Lo = Minimum programmed value of the whole measuring range.

RDG = Displayed Value.

0-10 VDC Output signal

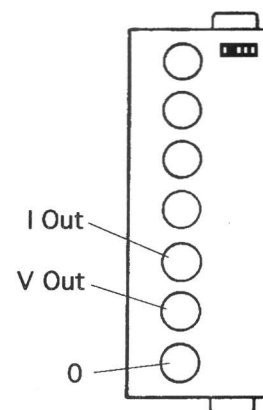
Relationship between output signal and displayed value: $V = 10(RDG-Lo) / Hi - Lo$

V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value



Relationship between over/underrange situations and Analog outputs:

Input signal to Hawk II	Display Indication	Output 4-20mA	Output 0-20mA	Output 0-10 V
Overrange	EE	20 mA	20mA	10 V
Underrange	- EE	4 mA	0mA	0 V

NOTE:

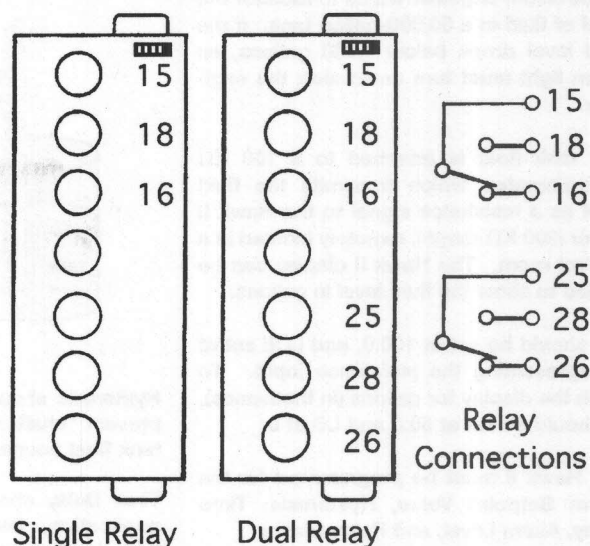
Analog output is not available in conjunction with Excitation.

Output Range	Accuracy	Temperature Drift	Max. Load Resistance	Output Resistance	Short-Circuit Protection
4-20 mA	±1% ±0.1 mA	±200 ppm/°C	500 Ohm	N/A	Yes
0-20 mA	±1% ±0.1 mA	±200 ppm/°C	500 Ohm	N/A	Yes
0-10 V	±1% ±0.05V	±200 ppm/°C	N/A	≤3 Ohm	Yes

Relays

Optional relays are available with the Hawk II. The relays are 5 amp, 250 VAC, SPDT models. Up to 2 relays can be installed in the Hawk II controller. The relays are programmed through the software in the Hawk II to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the setpoints. Hysteresis is easily programmed in the Hawk II to eliminate "chatter" in the relays. The Hawk II has a Time Delay adjustment of 0 to 99 seconds for the setpoints.

Relays can be used to "turn on" or "turn off" power to a process that the Hawk II is monitoring. A light can be "turned on" when a setpoint is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk II can be controlled with the relays by wiring them together, "turning on" or "turning off" the excitation when a setpoint is reached or exceeded.



Programming the Relays

The Hawk II automatically senses if a relay card is present in the instrument. Programming continues after you have set the **HI** parameter. When relays are present you must program the following values (in this order):

- Setpoint Values
- Hysteresis
- Time Delay
- High or Low Alarm Levels
- Relay Status
- Overrange Status

The programming for Setpoint Value (**SP1**), Hysteresis (**HYS**), Time Delay (**dEL**), High (**uP**) or Low (**do**) Alarm levels, Relay Status (**nE** and **nd**) and Overrange Status (**On/OFF**) are performed in the same manner:

1. The display will show **SP1** (or other programming variable), and then display the stored setpoint value.
2. To retain the present value, press the "**S**" key to pass to the next parameter.
3. To select a new value, press the **▲** or **▼** to increase or decrease the displayed value.
4. Press "**S**" when you have reached your desired value to pass to the next parameter.

Setpoint Values: The setpoint is relative to the display span and not to the electrical input range. Please remember that you can program a password to enable only the setpoints to be changed. This allows the operator flexibility in using the Hawk II, without the potential for erroneous programming of other parameters. If an incorrect password is entered, the program jumps to the **SP1** mode. If the correct password is entered (100-199), the operator can change the parameters.

Hysteresis: Hysteresis is the difference between the programmed setpoint value (value at which the alarm is set ON) and the value at which the alarm is disabled. If a reading is flipping between two points that are above and below the setpoint, this can cause the relay to "chatter" on and off rapidly. Hysteresis helps eliminate this "chatter" in the relays. The hysteresis value is selected from 1 to 1999.

Time Delay: The Time Delay is programmable from 0 to 99 seconds. Time Delay is similar to Hysteresis, but instead allows the input to exceed the setpoint for a specific amount of time before triggering the relay. For example, 2 would delay the relay from energizing for 2 seconds after exceeding the setpoint. The Time Delay is reset when the input falls below the setpoint.

High and Low Alarm Levels: You must choose if the relay is to be triggered when the input exceeds (for High Alarm = **uP**) or falls below (Low Alarm = **do**) the setpoint.

Relay Status: This parameter determines the state of the relay in the absence of an alarm: Normally Energized or Normally De-Energized.

Overrange Status: This allows the user to choose if the relay is on or off in an overflow/underflow condition.

At this point, if a second relay is also installed in the unit, **SP2** will be displayed and this procedure repeated for the second relay. After all parameters have been programmed, the programming mode is terminated automatically, and the system restarts. In normal operation, the setpoints can be displayed by pressing the **▲** key to show **SP1**, or the **▼** key to show **SP2**.

Application Example

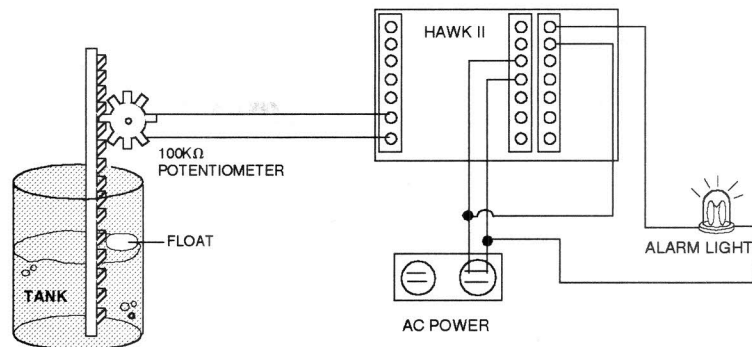
A petroleum engineer wants to monitor the level of fluid in a 50,000-gallon tank. If the fluid level drops below 1,000 gallons, an alarm light must turn on to alert the engineer.

The tank float is attached to a 100 K Ω potentiometer, which transmits the fluid level as a resistance signal to the Hawk II meter (200 K Ω range), remotely located in a control room. The Hawk II display can be scaled to show the fluid level in gallons.

HiE should be set at 100.0, and LOE set at 0, representing the resistance input. To scale the display for gallons (in thousands), Hi should be set at 50.0 and LO at 0.

The Hawk II must be programmed for the Alarm Setpoint Value, Hysteresis, Time Delay, Alarm Level, and Relay Status.

The Alarm Setpoint Value should be set at 1.0 to trigger the alarm at 1,000 gallons.



Hysteresis should be set at 5. This will prevent "chatter" in the relay, should the tank float bounce on the surface.

Time Delay should be set at 0. In this application, the alarm light should be turned on immediately.

Set the Alarm Level for down ("do") so that

the relay is energized when the signal drops below the Alarm Setpoint Value.

Relay Status is normally de-energized (nd), representing the relay status in the absence of an alarm situation.

The Hawk II will now display the fluid level.

Ordering Information

Basic Unit		Output Signal		Excitation	
H235	3-1/2 Basic Unit	0	None	0	None
		1	4-20 mA	1	12 VDC
		2	0-20 mA	2	24 VDC
		3	0-10 V		
Power Supply		Function/Range		Number of Relays	
1	120 VAC	0810	200 Ω	0	None
2	220 VAC	0820	2 K Ω	1	One
3	24 VAC	0830	20 K Ω	2	Two
4	48 VAC	0840	200 K Ω		

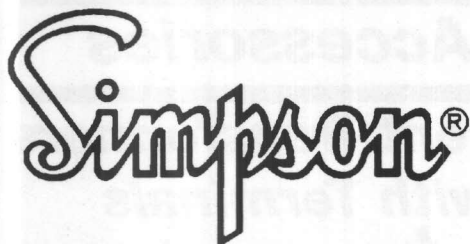
Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.



Accessories

Current Transducers

- Reduces AC Current Signals Down to 4-20 DC mA
- Seven AC Current Ranges Available
- Accuracy $\pm 0.5\%$ F.S.
- Perfect for Use with Digital DC Process Panel Indicators and Controllers
- Screw Terminals for Easy Connection
- Operates on 24V DC Power



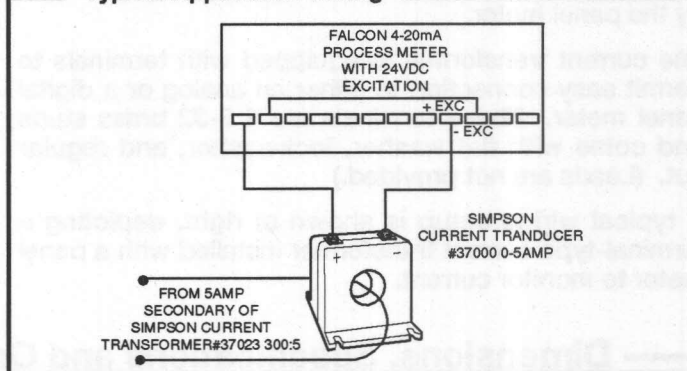
Current transducers expand the capability of a DC Process panel meter to include monitoring AC Current levels. The current transducer converts the AC Current into a 4-20 DC mA output signal, which can be monitored by the Process meter.

The current transducer requires a power supply of 24 VDC, which can be provided by a DC Process meter with 24 VDC excitation output. Most Process meters also allow easy display scaling to indicate the level of AC Current being measured.

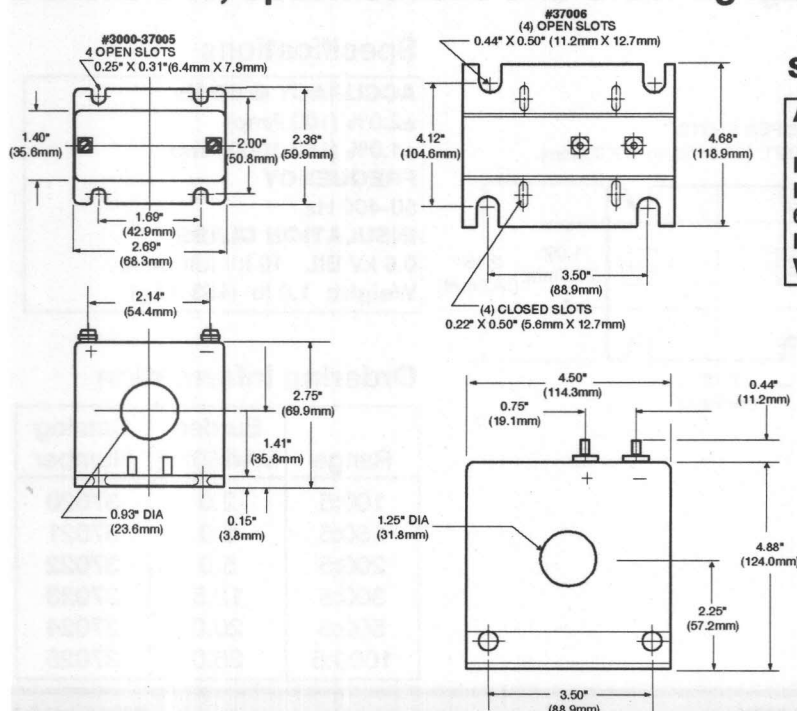
To measure AC Current over 300 Amperes, the 5 Amp current transducer #37000 may be used in conjunction with a current transformer with 5 Amp secondary, as illustrated at the right. The current transformer mea-

sures the primary current, and the transducer is connected to the Process meter, which is scaled to display AC current.

Typical Application Wiring



Dimensions, Specifications and Ordering Information



Specifications

ACCURACY: $\pm 0.5\%$ F.S. max.	TEMP. EFFECT: Accuracy: $\pm 0.04\%$ / °C
FREQUENCY: 60 Hz	Operating: -30°C to +65°C
INSULATION CLASS: 600 V	Storage: -55°C to +85°C
MAX. OUTPUT: 30DCmA	SUPPLY VOLTAGE: 24 VDC $\pm 10\%$
WEIGHT: 1.5 lb (680.39 g)	

Ordering Information

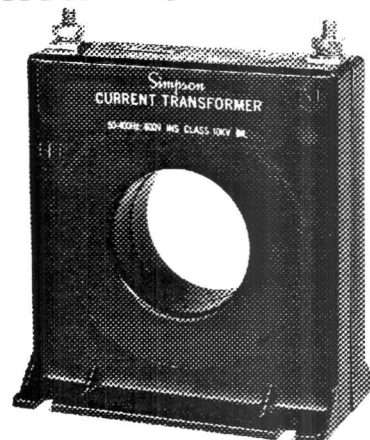
Input Current Range (ACA)	Output Current Range (DCmA)	Catalog Number
0-5 A	4-20 mA	37000
0-50 A	4-20 mA	37001
0-75 A	4-20 mA	37002
0-100 A	4-20 mA	37003
0-150 A	4-20 mA	37004
0-200 A	4-20 mA	37005
0-300 A	4-20 mA	37006



Accessories

Current Transformers with Terminals

- Reduces High AC Current Signal to 5 Amp AC Signal
- Six AC Current Input Ranges Available
- Accuracy $\pm 1.0\%$ ($\pm 2.0\%$ for 100 Amp)
- Screw Terminals for Easy Connection

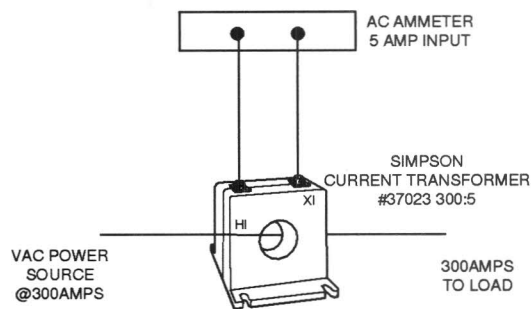


Simpson's terminal-type current transformers can be used to monitor AC Current when the current level is too high for the panel meter to be connected directly in series, usually above 75 Amperes. The current transformer reduces the primary input current to a secondary current of 5 Amperes, which can be monitored by the panel meter.

The current transformer is equipped with terminals to permit easy connection to either an analog or a digital panel meter. These terminals are # 8-32 brass studs and come with flat washer, lockwasher, and regular nut. (Leads are not provided.)

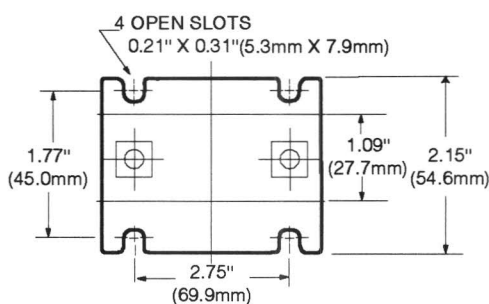
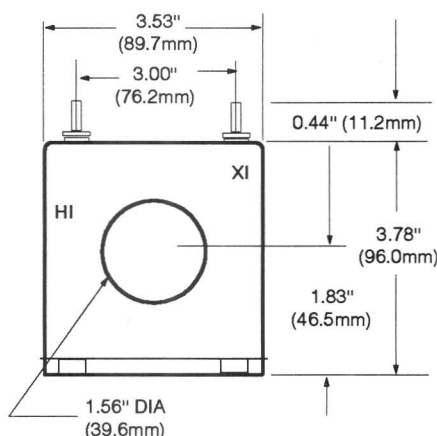
A typical wiring setup is shown at right, depicting a terminal-type current transformer installed with a panel meter to monitor current.

Typical Application Wiring



Dimensions, Specifications and Ordering Information

Dimension Drawing



Specifications

ACCURACY @ 60 Hz
 $\pm 2.0\%$ (100 Amp)
 $\pm 1.0\%$ (150-1000 Amp)
FREQUENCY
 50-400 Hz
INSULATION CLASS
 0.6 kV BIL 10 kV full wave
Weight: 1.0 lb (453.59 g)

Ordering Information

Range	Burden VA@60Hz	Catalog Number
100:5	2.0	37020
150:5	5.0	37021
200:5	5.0	37022
300:5	12.5	37023
500:5	20.0	37024
1000:5	25.0	37025